DEMOGRAPHY OF GUAM

FROM DATA TO INFORMATION

AN ANALYSIS OF BASIC DEMOGRAPHIC DATA FOR THE ISLAND OF GUAM

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An analysis of basic demographic data for the Island of Guam.

CENSUS and POPULATION DIVISION

DEPARTMENT OF COMMERCE

GOVERNMENT OF GUAM

by

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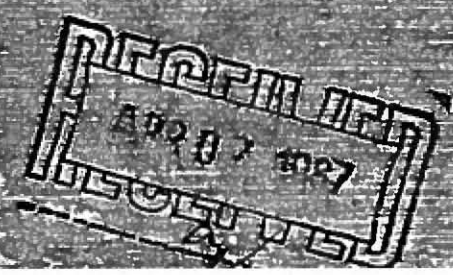

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ABSTRACT.

The study represents a demographic analysis of past censuses, conducted during the period of U.S. administration on Guam. It evaluates the consistency and usefulness of the demographic data that have been collected and, on the basis of this, creates demographic profiles, population projections and recommendations for future activities in the field of demography on Guam.

Demographic information on Guam stems from two sources: the decennial census and the vital registration system. The analysis is based on eight variables from the census. These are: age, sex, ethnicity, children ever born, children surviving, children born last year, place of birth and place of residence five years prior to the census. These variables are used in conjunction with three variables from the vital registration system: age, sex, ethnicity. These variables generally suffer from limited availability and level of detail. This is not so much caused by constraints in data gathering, but rather the limited extent of applied tabulation programs.

Assessing the quality of data reporting faces problems due to non-stability of the population. Dissemination of data for the aggregate population into a component for Chamorros, the native population of Guam, proves to be a requirement for meaningful assessment and monitoring of population trends. Other ethnic groups generally cannot be treated separately because of their low numbers, which results in a range of fluctuations.

Of the identified variables, ethnicity presents increasing problems. Children Ever Born appears to reflect improved reporting, although selective underreporting of those CEB who have died results in apparent relative overreporting of the variable Children Surviving.

Guam's population size and composition since World War II has been seriously affected by migration. This has caused unprecedented population growth and resulted in lopsided population compositions, the non-Chamorro population groups showing large excesses of males in the working ages. With increasing aggregate population these imbalances tend to become less pronounced. The major ethnic groups as of 1980 are Chamorro (45%), Caucasian (25%), Filipino (21%) and "Others" (9%). The former two categories are stagnating in their growth, while the latter two experience rapid increase.

After a postwar baby-boom Guam's Chamorro population has experienced a very substantial decline in fertility, a process that has not yet completed its course. Crude Birth Rates have dropped from a prewar average of about 50 per thousand to about 26 per thousand in 1984. Total Fertility Rates are only available for the aggregate population, but indicate a similar drop, from 5.8 in 1960 to 3.2 in 1980. Age Specific Fertility Rates for the aggregate population indicate a drop in the Median Age at Childbearing from 26.8 in 1960 to 25.6 in 1980.

Mortality has dropped ever since the early part of this century. Its development is most apparent in the values for Life Expectancy at Birth. These have increased from 42.7 and 43.4 in 1930 to 69.3 and 75.4 in 1980, for males and females of the aggregate population respectively. Mortality for Chamorros shows the same development, although on an increasingly lower level, especially for males. The decline in mortality appears to have come to an end, as is indicated by a relatively constant level of Life Expectancy for males since the early 1970s.

The interplay of trends in fertility and mortality are indicative of the process of Demographic Transition. It is concluded that this process started around 1910 with a moderate decline in mortality, followed by a rapid decline in fertility following the aftermath of World War II. Mortality has reached a

constant level in recent years, while the component of fertility continues to decline. When this decline in fertility comes to an end it can be stated that the Demographic Transition has been completed.

Limitations in the data, useful for gaining insight in the processes of migration, allow only information on Net Migration to fulfill this purpose. Two waves of migration can be identified: one shortly after World War II, comprised of the inmigration of about 22,000 Caucasians, mainly military service personnel, and about 7,000 Filipinos, for the most part construction workers. A second wave occurs since the early 1970s, and is basically different in character. It consists of net outmigration of Chamorros and Caucasians on the one hand and net inmigration of Filipinos and "Others" on the other hand. Information on Net Migration by age and sex indicates that inmigrants tend to be younger than outmigrants, while male inmigrants tend to be younger than female inmigrants. There is also some evidence that many of the outmigrants are young families with children just before schoolgoing age.

Four series of population projections have been developed, a high, low and medium variant and a variant that would result in a stable population. The first three include the three components fertility, mortality and migration while the fourth assumes zero net migration along with constant fertility and mortality. All series run up to the year 2020. Series 1 results in a total population of 174,396 for thatyear, series 2 in 189,779, series 3 in 207,204 and series 4 in 227,081. For the year 2000 these values are 145,393, 149,274, 153,772 and 160,936, respectively. This means that future population growth will remain moderate, which is mainly due to the identified decline in fertility and the loss of population through net outmigration. The structure of the (aggregate) population will become increasingly unbalanced toward the year 2020, females outnumbering males in almost all age groups. The proportion of elderly people, especially females, will increase almost tenfold over these 40 years, while the proportion of population of schoolgoing age will diminish.

Based on the observations in the study several recommendations for future action are presented. These address the need for additional tabulations that will disclose information that has hitherto been unavailable or of limited use. Cross-tabulations against the variable "ethnicity" and/or an additional variable "military affiliation" are the main concern on Guam. Suggestions for change in the census questionnaire for the 1990 census remain limited to the addition of a question that explicitly inquires into the practice of adoption. It is believed that this will also improve the response to the other questions on fertility. Special instructions for the enumerators or rephrasing of the questions on Children Ever Born and Children Surviving may add to the quality of the response to these questions. Additional recommendations focus on the need for surveys on the topics of fertility and migration.

PREFACE

Objective of the Study.

The present study has been designed to serve several purposes simultaneously. These can briefly be summed up as follows:

a) indicate sources of demographic information that are available on Guam,

b) assess the accuracy, completeness and consistency of this information,

c) create a body of consistent demographic information, derived from available demographic data that have been gathered during the period of U.S. administration on Guam,

d) present several series of population projections with discussion of implications of these, based on the previously established data base.

e) make recommendations for future data gathering efforts, such as demographic surveys and especially the 1990 census of population.

It need be stressed that a census is an expensive vehicle for obtaining information. Yet, it is the most important one, which appears to be recognized through its implementation by law. As a consequence, equal attention should be paid to the task of processing census data from bits of raw data to meaningful information. Such a procedure is essential to justify the above mentioned high expenditures and is generally being considered an inherent part of any census operation.

Need for the Present Study.

In August 1985 the, then, SPC/UNFPA population advisor, Dr. Hartmann, wrote a report based on information gathered during several visits to Guam. He observes

that only a small proportion of existing census data on Guam has been analyzed, and as a result, "...there has been virtually no incorporation of census data in development planning and administration." Dr. Hartmann also notes several distinct population data needs, related to optimizing programs in the areas of, for example education, health care, public utilities and employment.

From his report, several reasons for the present suboptimal situation can be identified. First of all, an organizational structure based on non-centralized government agencies generally is not conducive to a satisfactory level of interagency cooperation. Secondly, a census operation frequently suffers from a considerable time-lag between data collection and publication of tabulations for analysis. In the case of Guam, for example, tabulations of the 1980 census became available in November 1984, rendering the results outdated by the time they were received. Thirdly, a census program is incomplete if it does not include plans for analysis of the collected data. Such is the case on Guam. Fourthly, questionnaires have been implemented in past censuses that were less than optimal in the context of Pacific islands. Fifthly, available census information suffers from limitations in its contents, for instance the lack of separate age- and sex-specific tabulations for the military and nonmilitary populations on Guam. Other limitations will be elaborated upon in subsequent sections of the present report. Sixthly, other sources of demographic information on Guam have been underutilized, such as a demographic survey program, that could be used to generate information on issues of special local interest. Lastly, so far there has been no comprehensive demographic analysis of the demographic data base that actually is available.

It must be noted that the above has stimulated a development which is cause for serious concern; various agencies have started to generate statistics on demographic topics, tailored to their own needs. More often than not they have done so without the required expertise, employing criteria and definitions that

vary over time within and between agencies, thereby often being forced to duplicate each others work.

As a consequence of his observations Dr. Hartmann made some tentative recommendations for future production and analysis of population data at the Guam Department of Commerce, which, as counterpart of the U.S. mainland institution hosting the U.S. Bureau of the Census, seems the most appropriate agency to generate population data and appears to bear the most potential in concentrating efforts to do so. His recommendations can be perceived as phases in a plan of action that would look as follows:

1) perform a demographic study that will serve to indicate the state of knowledge that can be achieved from the existing demographic data base and will identify limitations of as well as suggest modifications for the present state of affairs.

2) modify the organizational structure that is at present responsible for generation and utilization of population data, i.e. create a large, centralized office for this purpose.

3) implement a demographic survey program in addition to the (decennial) census to fill in gaps and serve areas of special demographic interest.

The present study represents the first phase in this plan of action, providing basic information that hopefully will stimulate the government agencies involved to consolidate their respective efforts in generating and utilizing data on population.

Acknowledgments.

This research project has been financially supported by the Guam Department of Commerce. For this and the many other ways in which the people at this department have stimuated my work I am very grateful.

The present report is to a large extent based on two sources of demographic data. Acknowledgment is hereby made to the agencies that have generated these data. For the census data this is: U.S. Bureau of the Census, division of the U.S. Department of Commerce. For the data on vital statistics these are: Records and Accounting Office, division of the U.S. Department of the Navy and the Office of Vital Statistics, division of the Guam Department of Public Health and Social Services.

Additional information has been obtained at the Micronesian Area Research Centre, which has also provided invaluable assistance for my research project in a variety of ways, for which I am very grateful.

Printing of draft versions of the report and plotting of the included graphs was done at the office of Research, Planning & Evaluation and the Learning Resources Centre, both of the Guam Department of Education. I hereby wish to thank these agencies and especially their respective administrators, dr. Jeffrey E. Shafer and Richard T. Sorby.

I feel greatly indebted to a great many people who contributed in one way or another to make my stay on Guam an unforgettable experience and whose continued support made it all possible. Only a few of them can be mentioned here, but I am sure that many others will know that they have not been forgotten. Please allow a sequence in order of appearance: Prof. F.H.A.G. Zwart, Dr.Ir. Bert van Norren, Drs. Harry A.W. van Vianen, Dr. Jeffrey E. Shafer, Henry M. Cruz, Joseph T. Flores and all others at the Guam Department of Commerce, Dr. Michael Hartmann, Dr. Michael Graves, Albert L. Williams and the rest of the staff of MARC, Julita V. Santos, Bobby D.C. Santos, Bea C. Acfalle, the staff of Research, Planning and Evaluation and Victoria Tirey.

INTRODUCTION.

Sources of Demographic Data.

Most countries in the world organize periodical enumeration procedures that are called censuses. Although in most cases this is a very costly event, there is good reason for them to go through such a procedure: a census is the only vehicle through which actual, complete quantitative and qualitative information on selected topics pertaining to a nation or territory can be obtained.
In the U.S.A. these topics fall into three broad categories: agriculture, housing and population. Of these, population can be considered the most basic since it provides the denominators for most measures that relate to a society. The census of population is conducted in conjunction with the census of housing on a decennial basis. Their results are being published in the same volume(s), along with many cross-tabulations.

The present demographic analysis is only involved with those variables that directly influence the size and composition of a population, i.e. fertility, mortality and migration. In the rest of this study, when the term "census" is used, it is meant to refer to "census of population".

For many countries a census is the only source of information on population size and composition. Those countries usually lack an adequate system of vital registration; the continuous recording of events through which persons are added or lost to a population. Such events are births, deaths and migration. Only rarely are data onmigration collected in a vital registration system, however. The U.S.A. is no exception. Like the census, a system of vital registration is often employed to record events that are of secondary importance for purposes of demographic analysis. Statistics on nuptiality are one broad category of data that exercise their influence only indirectly, through fertility.

It is generally recognized that there are three major sources of demographic data: the population census, the vital registration system and (demographic) sample surveys. A few countries also employ a so-called "population register" from which demographic data can be abstracted. So far, the third category has received virtually no attention on Guam. The only demographic sample survey that has ever been conducted on Guam took place in 1968, and focused exclusively on voluntary birth control. It was a so-called "Knowledge, Attitude and Practice" study, carried out shortly after a family planning program had been implemented on Guam. It is more than likely that problems inherent to designing a sample on Guam may have given rise to the lack of attention given to this potential data source. Briefly stated, these problems stem from difficulties in arriving at a base population that is representative of Guam's aggregate population. The fact that Guam's resident population consists for about 20% of military service personnel and their dependents, whereas this distinction has never been made in any of the census tabulations, lies at the core of the present situation.

The census in conjunction with an adequate vital registration system generally forms a sufficient basis for comprehensive analysis of population data. Areas of special interest can be investigated by making use of sample survey programs. Only rarely are the two main sources of data adequately covered, however. In such cases demographic sample surveys may be employed to to fill in gaps that are left by them. Guam is fortunate in having both a census and a vital registration system whose long histories have made them become well accepted institutions, implying a potential high quality of reporting.

In 1901 a census was conducted under supervision of the naval governor. Registration of births and deaths which had ceased after Guam's seizure from Spain resumed in the same year. For the next fifty years the vital registration system of Spanish origin was in fact continued, the most notable change being the use of English instead of Spanish language on the registration forms, from 1906

onwards. A second census under the authority of a naval governor was conducted in 1910. From 1920 onwards the population of Guam was enumerated in conjunction with the regular decennial censuses of the U.S., the field work being done under the supervision of the naval, and from 1950 onwards, civilian governor, but all other organizational aspects taken care of by the U.S. Bureau of the Census. In November 1944 an enumeration was performed by the U.S. Department of War, as part of attempts to make an inventory of what was left after the liberation had taken place. Subsequent counts were conducted by the U.S. Department of the Navy during the years 1946 to 1949.

In 1955 the vital registration system underwent one major change with the introduction of U.S. standard registration forms. These forms display detailed categories of information which are pre-coded, allowing automated tabulation to take place. On Guam, the final step towards computer-storage of these data has been taken in 1985, holding great promise for future statistical analysis of this vast body of data.

Census Comparability.

This section is intended to discuss enumeration procedures that have been followed by the U.S. Bureau of the Census. For the sake of completeness brief mention will also be made of enumerations that occurred during the years following World War II, conducted by the Department of War and later the Department of the Navy. These enumerations do not constitute censuses in the sense of having been conducted at regular intervals, referring to well defined exact points in time and employing well defined criteria for enumeration. They occurred on average four times a year and presented data in a crude classification into resident and nonresident population. The nonresidents were identified according to military division or employing company. Residents as well

as nonresidents were occasionally grouped into males/females and over 16/under 15 years of age.

Census data since 1920 have been obtained by means of direct interview of the head of household and/or any adult present at the time of visit. The interviewing is done by enumerators who each cover a designated area. The census is conducted around an exact point in time to which the information obtained refers. For 1920 this was midnight of January 1st., for all subsequent censuses it was midnight of April 1st. The usual procedure is for an enumerator to visit each house before "census day", work through the questionnaire and return some time after "census day" to verify if anything changed between the first visit and "census day".

All censuses on Guam during this century have been conducted on a "de jure" basis. This means that individuals have been enumerated according to their usual place of residence. The well established practice of the U.S. Bureau of the Census is to define this as the place where a person lives and sleeps most of the time. When a person is reported absent other household members or neighbors are requested to report. In addition, persons who were away from their residence on census day were asked if there was anyone at their home to report them. Since 1970 a process of matching records is employed to detect and eliminate duplicate reporting of those who were absent from home but might be reporting for themselves elsewhere.

A special problem is presented by population groups that are highly migratory, i.e. persons in the U.S. armed forces, persons enlisted in the U.S. Navy, their dependents, crews of the American merchant marine and college students.

In the 1920 census "native" men enlisted in the U.S. Navy were included in the census tabulations, but U.S. naval station personnel were excluded. From 1930 onwards all military personnel, stationed on Guam, have been enumerated. The same goes for their dependents who have been enumerated where they were actually residing at the time of the census. Crews of U.S. Navy ships were from 1930 to

1950 attributed to the geographic area where the ship was stationed, in 1960 to the port where the ship was berthed at the time of the census and for 1970 and 1980 to the ships' homeport.

Crews of U.S. merchant marine vessels until 1940 were treated as part of the population of the port from which the vessels operated. Since then they are counted as part of the population where their vessels are berthed on census day. The last mentioned category, college students, also have been subject to changing enumeration procedures; from 1950 onwards they were considered residents of the communities in which they are residing while attending college, rather than as persons temporarily absent from their parental homes, which had been the practice before 1950.

Other population groups that have been consistently enumerated throughout the period include inmates of institutions who are enumerated where the institution is located, and patients in general hospitals who are allocated to their homes unless their stay exceeds a period of six months. Persons without a usual place of residence are counted where they are enumerated.

Basic information, essential for any census in order to create meaningful cross-tabulations consists of the variables age and sex. Without this type of information a census is merely a headcount. The census of 1920 is the first one for this century to collect this information. Since 1950 unreported age and/or sex has been estimated on the basis of other available information, a process called "allocation".

A third variable that must be deemed basic in the context of Guam is ethnicity. Although this information did not bear much importance before World War II when over 90% of the resident population could be classified as Chamorro, after 1950 it became the only criterion that could be used to identify the Chamorro population group among the huge masses of newly arrived immigrants. Consistent classification into ethnic groups, each of which has its specific

demographic characteristics, allows continued monitoring of the demographic behavior of these groups and may serve to eliminate distortions in demographic statistics, resulting from lumping together several unequal population groups.

From 1930 to 1960 the assignment of an individual into an ethnic group (the term "race" was used, however without the usual connotation of biological stock, therefore strongly resembling present-day usage of "ethnic group") was arrived at through the enumerators' observation. In the case of mixed parentage race of the non-white parent was recorded. If both parents were non-white, race of the father was used as criterion. Where the enumerator failed to report race for an individual the classification was made in the editing process. This method of classification was abandoned with the 1970 census. This census presents serious limitations in deriving information related to the variable "ethnicity". One variable that is known to be correlated with ethnicity is the country/territory of birth, although this correlation is not perfect. Using the latter variable as a substitute for the former would result in problems of comparability with other censuses. The problem of determining ethnicity evolved again in the 1980 census. Now it has been solved by asking a question based on self-identification: "What is your ethnicity?". Although this solution may be the most practical under circumstances where great ethnic diversity and intermixture has developed, it is unfortunate in the sense of allowing a considerable level of arbitrariness from the respondents' side. This is reflected in the large number of unacceptable entries such as "American" and names of religious groups.

A census can be used to estimate a variety of measures that reflect fertility and mortality without relying on a vital registration system. Data on reported number of Children Ever Born (CEB), Children Surviving (CS) and children born during the year preceding the census are highly useful in this regard.

Since 1960 a question on CEB has been included in the census. The question asked is: "How many babies has (the woman) ever had, not counting stillbirths?". For the 1960 census this question was asked only of women who had ever been married. It was expected that this would not seriously affect the quality of reporting, on the assumption that many women who had had an illegitimate child would have been reported as being or having been married (the term marriage includes consensual unions). Nevertheless, the very high level of illegitimate births on Guam, the related practice of adoption and a powerful doctrine of the Catholic church, condemning out-of-wedlock unions, gives rise to the suspicion that underenumeration of illegitimately born children will have resulted from this practice. This suspicion will be substantiated in the next chapter. Although the question on CEB was asked of all women over 15 years of age in the 1970 census, data were tabulated only for women ever married, so as to assure comparability with the earlier results. The 1980 census employed again the same question, but tabulations were done for all women aged 15 years and over. However, it was explicitly noted that data on CEB reported by never married women should be viewed with caution because of the very high rates of non-response to the question and the anticipated underreporting of live births to these women. The 1980 census was the first to ask a question on the number of Children Surviving and one on the number of children born during a period of exactly one year prior to the census.

Two variables in the censuses can be useful for analyzing the third major component of population change: Place of Birth (POB) and Place of Residence five years prior to the census. POB data have been recorded on Guam ever since the 1920 census. Place of Residence five years prior to the census has been recorded from the 1970 census onwards.

FIGURE 1 (a)

GUAM 1930

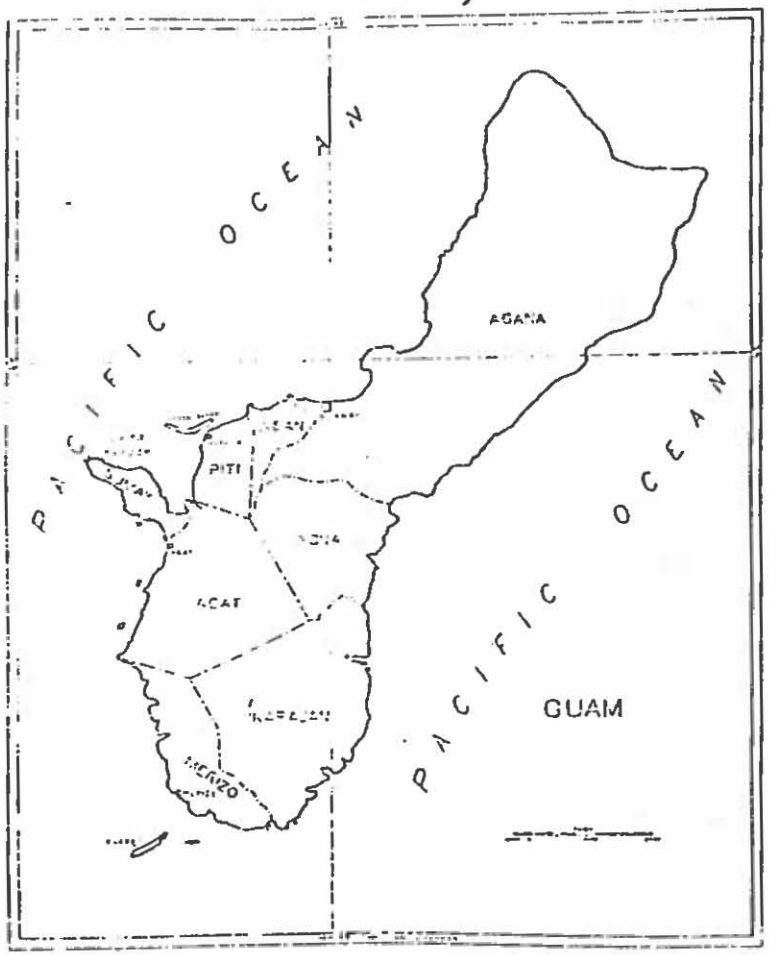


FIGURE 1 (b)

GUAM 1940

MUNICIPALITIES AND TOWNS

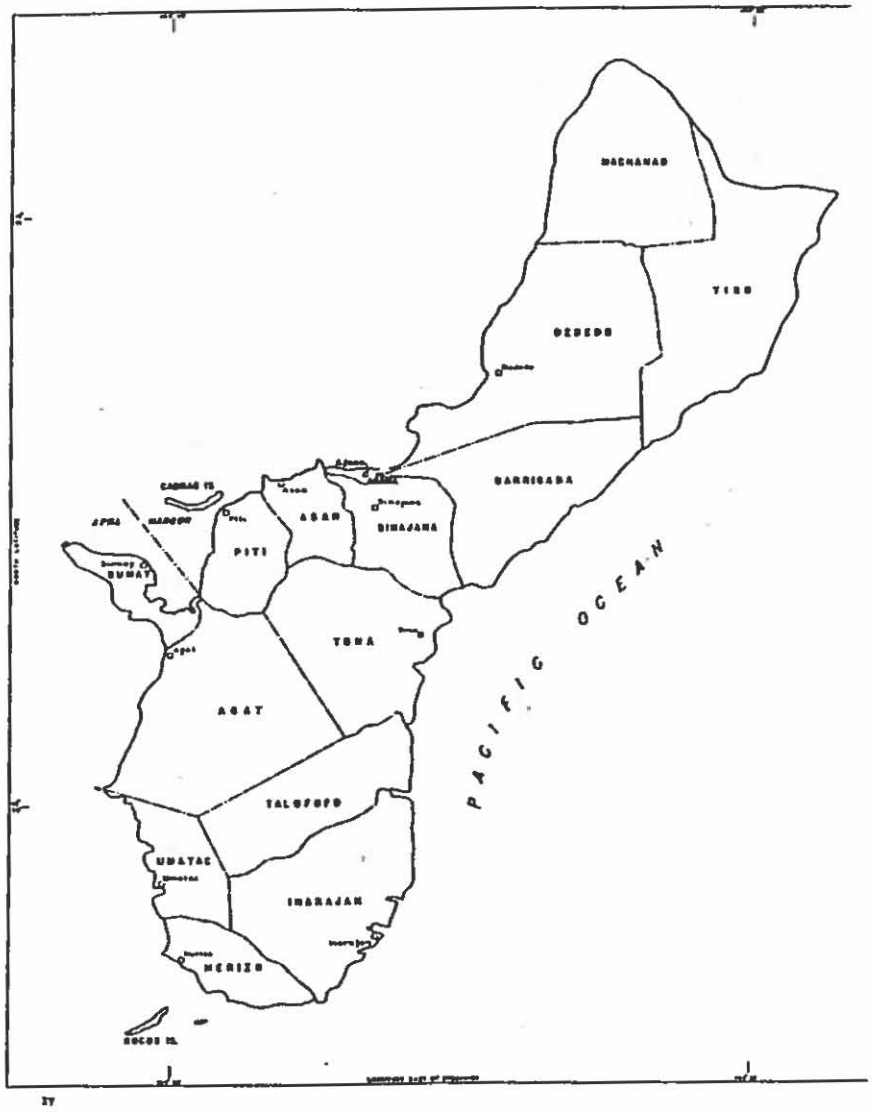


FIGURE 1 (c)

GUAM 1950

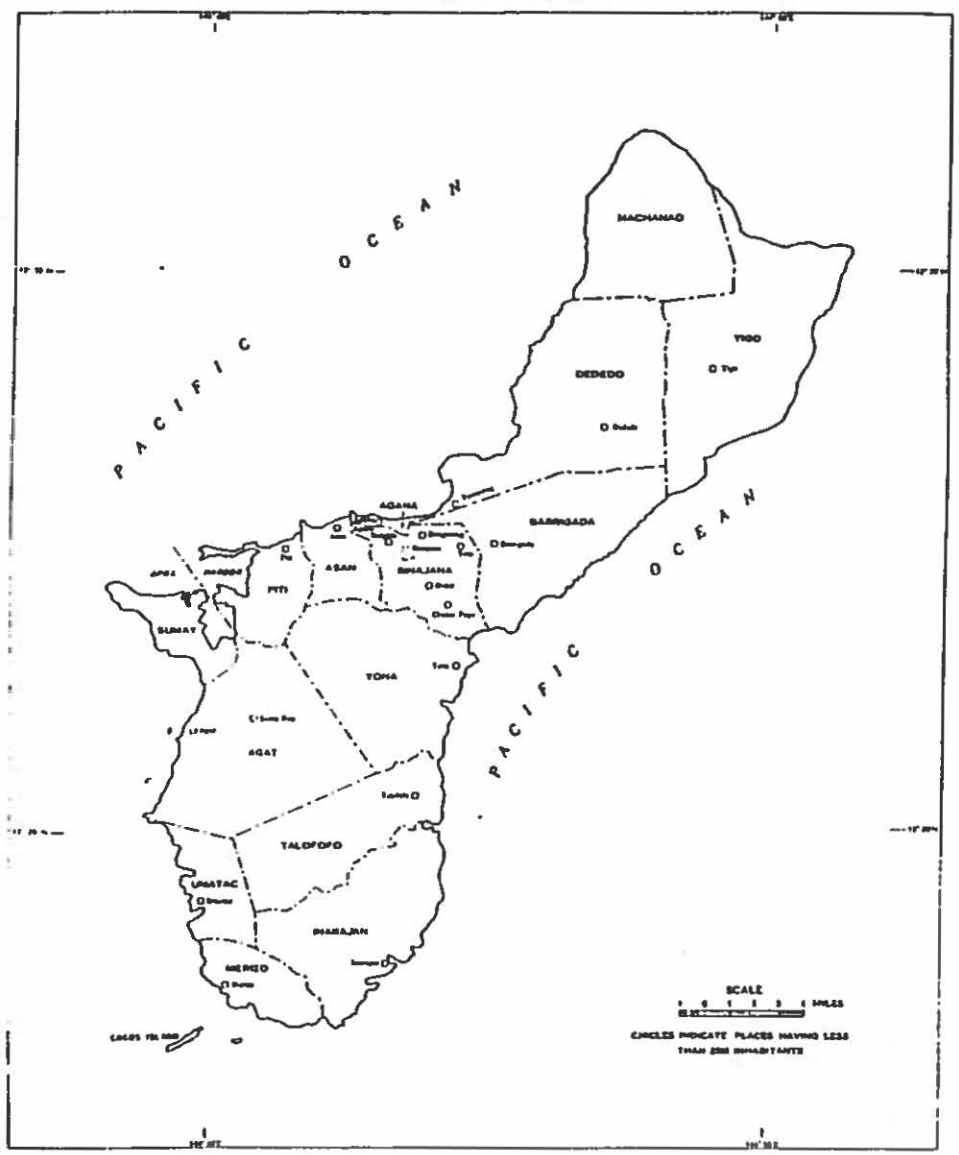
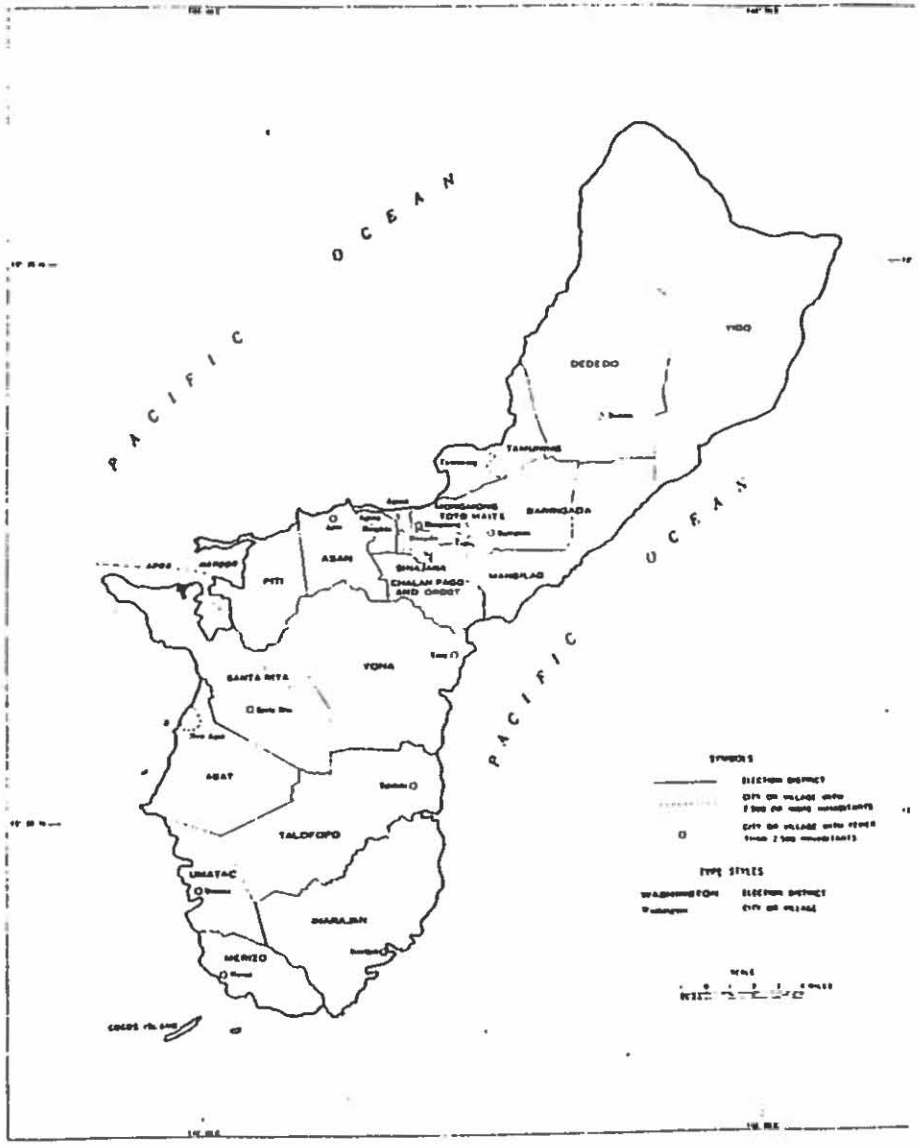


FIGURE 1 (d)

GUAM—ELECTION DISTRICTS, CITIES, AND VILLAGES 1960



A final remark must be made regarding changes in Guam's aerial subdivisions. Between 1930 and 1940 extensive redistricting of Guam's municipalities took place. Following World War II the administrative concept "barrio" was replaced by "place", which is subdivided into "village" and "city". The division of Guam into municipalities was abandoned in 1956 and superseded by an arrangement according to election districts. Figure 1 broadly outlines some of the changes as they occurred over time.

As far as the concept of urbanization is concerned it should be noted that in the census reports a special definition of this concept is employed for use on Guam. According to this definition, an urban area is a concentration of over 2,500 residents within one administrative unit. It must be emphasized, however, that this does not allow comparison with other nations or territories where other definitions may be employed.

Reporting of Census Data.

In the above section eight variables that will be of main concern in the present study have been identified. As can be observed from the way data on CEB have been gathered on the one hand and tabulated on the other, registration in itself is no guarantee that the data will be fully available. Although it is generally possible to obtain specific tabulations from the U.S. Bureau of the Census, most users of census data will rely on the tabulations that are readily available in the published reports. Table 1 presents an overview of the various cross-tabulations of the eight identified variables that have been published in census reports since 1920. For a variety of reasons even these published cross-tabulations often lack consistency, caused by varying levels of detail in the presentation of especially the variables "age" and "ethnicity".

TABLE 1

CROSS-TABULATIONS IN CENSUS REPORTS FOR SELECTED VARIABLES, GUAM.

VAR.1 \ VAR.2	AGE	SEX	ETHNICITY	CHILDREN EVER BORN	CHILDREN SURV.	CH.BORN PREC.YR.	PLACE OF BIRTH
AGE	*	2,3,4,5, 6,7,8	3,4,5,6, 8	6,7,8	8	8	8
SEX	2,3,4,5, 6,7,8	*	3,4,5,6	-	-	-	8
AGE & SEX	*	*	3,4,5,6	-	-	-	8
SEX & ETHNICITY	3,4,5,6	*	*	-	-	-	-
AGE & ETHNICITY	*	3,4,5,6	*	6	-	-	-
PLACE OF BIRTH	8	8	8	8	8	8	*
PLACE OF RES.5Y.AGO	8	8	-	-	-	-	8

Notes:
2,3,...8 refer to censuses of 1920,1930,...1980, respectively.
* = not relevant
\- = not existent

TABLE 2

TABULATION OF AGE BY SELECTED VARIABLES, GUAM.

AGE BY:

SEX		ETHNICITY							FERTILITY VARIABLES		
1980	1970-1960	1950-1940	1930	1920	1980	1960	1950-1940	1930	1980	1970	1960
SINGLE YEARS UP TO AGE 90	SINGLE YEARS UP TO AGE 21	< 1 1-4 5-9 10-14 15-19	< 1 1-4 5-9 10-14 15-19	0-4 5-9 10-14 15-19	0-4 5-9 10-14 15-19	SINGLE YEARS UP TO AGE 21	< 1 1-4 5-9 10-14 15-19	< 1 1-4 5-9 10-14 15-19	15-19		15-19
	20-24	20-24	20-24	20-24	20-24	20-24	20-24	20-24	20-24	15-24	20-24
	25-29	25-29	25-29		25-29	25-29	25-29	25-29	25-29		25-29
	30-34	30-34	30-34	25-34	30-34	30-34	30-34	30-34	30-34	25-34	30-34
	35-39	35-39				35-39	35-39				35-39
	40-44	40-44	35-44	35-44	35-44	40-44	40-44	35-44	35-44	35-44	40-44
	45-49	45-49				45-49	45-49				
	50-54	50-54	45-54	45-54	45-54	50-54	50-54	45-54	45-54		45-54
	55-59	55-59			55-59	55-59	55-59		55-59		55-59
	60-64	60-64	55-64	55-64	60-64	60-64	60-64	55-64	60-64		60-64
	65-69	65-69		65+	65+	65-69	65-69		65+		65+
	70-74	70-74	65-74			70-74	70-74	65-74			
	75-79	75+	75+			75-79	75+	75+			
	80-84					80-84					
	85+					85+					
90-94											
95-99											
100+											

Tabulations of ethnicity largely reflect the actual make-up of the population. From 1930 through 1950 five categories were distinguished in the census publications: White/Caucasian, Chamorro, Filipino, Chinese and "Others". In 1960 this was reduced to four categories by merging "Chinese" and "Others" into one category. In contrast, the 1980 census report shows a great many ethnic groups. Two overall categories, "single" and "multiple" ethnic groups are subdivided into 25 and 6 subgroups, respectively.

Presentation of the variable "age" has two dimensions that are relevant in the present context: for the variables on fertility this is the age group of the mother, for all other variables age groups relating to the whole population are involved. Table 2 summarizes the tabulations of this variable, according to the two dimensions. It must be noted that both migration variables are not involved in this table.

Reporting of the variable POB suffers from similar limitations as the variable "ethnicity". Prior to 1940 a basic distinction between those born in the U.S.A. and those born elsewhere was made. The former category comprised Guam, Hawaii, Continental U.S.A. and "Other territories and possessions" (including the Philippines) while the latter category was made up of Northwestern Europe, Other Europe, Asia and "Other countries". In the 1950 census report the newly independent Republic of the Philippines made up a separate category among those that already existed. In the report on the 1960 census some merging of categories took place, resulting in a distinction between Guam, U.S.A. and "Other outlying area" on the one hand and Europe, Republic of the Philippines, Other Asia and "Other countries" on the other hand. The 1970 census presents a more detailed picture, employing somewhat different categories, however. Those born in the U.S.A. are subdivided in three categories: U.S. territory, Puerto Rico and U.S.A. Foreign born persons are grouped into 23 categories that are arranged by continent. Although the report on the census of 1980 is also quite detailed in

its POB classification, it has a different focus; it distinguishes between Guam, U.S.A., Philippines and two other Asian categories, 7 categories of Pacific islands and a category "elsewhere".

Comparability of Vital Statistics.

Guam's vital registration system has a remarkably long history which, as indicated earlier, has its roots in the Spanish colonial era. Although this report is not concerned with analysis of demographic data for that period other writers have pointed out that, generally spoken, the Spanish administrators kept meticulous records. When the U.S. Navy took over control of the island, the vital registration system apparently was found adequate enough to be reinstalled and kept on functioning in its basic form until 1955. Even the period of the Japanese occupation is covered by the records, although registration of vital events came to a halt for 2.5 years. Vital events (i.e. births and deaths) for this period were recorded during the years following the liberation of Guam from those who survived. The registration of vital events is enforced by law. The usual practice is for the hospital, midwife or immediate relatives to report the event to the Office of Vital Statistics (or Records and Accounting Office before 1952) which issues birth or death certificates. According to law, all births and deaths occurring on Guam have to be registered on Guam. For the last 10-15 years this practice may have resulted in an underregistration of deaths due to the exclusion of mortality among Guam residents who have left the island to undergo medical treatment elsewhere. Increasing mobility, wealth and heart diseases may largely account for this development. The exact number of such cases is unknown, as it is equally unknown if these may be balanced by deaths to individuals who are not residents of Guam occurring in Guam hospitals. The registration requirement has been consistently fulfilled ever since 1901. The only exception so far has been

the non-registration of Japanese and U.S. war casualties among the military troops, occurring on Guam.

Death records until 1955 contain information on the age of the deceased, generally stated in terms of years and months, but the younger the subject the more detailed the reported age. The individual's sex was not recorded, but can be derived from the person's full name. In cases where a baby had died before receiving a name it was mentioned in the records if the it was a boy or a girl. One somewhat confusing aspect in older records (especially before 1940) is a large proportion of entries without specified age. From the "cause of death" specifications it can be observed that these constitute "premature" deaths, occurring before the child had been born.

Like the census, the vital registration system since 1955 employs the variable "ethnicity". Before that year the death records do not specify ethnicity. Until 1945 this does not present much of a problem since the number of deaths occurring to non-Chamorros was very small and does not distort death statistics significantly. Moreover, the homogeneity of Guam's population composition at the time allows a fair estimate of ethnicity by noting an individual's name and reported residency. With increasing inmigration the number of non-Chamorros dying on Guam grew steadily, however, rendering indirect estimation of ethnicity of doubtful validity. Fortunately, the U.S. standard registration forms were introduced before this could become a serious problem. On these forms ethnicity is clearly identifiable.

Birth registration distinguishes between stillbirths and livebirths. Only the latter category is of interest in the present study. The definition of a livebirth is for all practical purposes identical to the one employed in the census enumerations: the product of human conception showing any signs of life after complete expulsion or extraction from its mother, irrespective of duration of pregnancy.

Birth records prior to 1955 suffer from somewhat more serious limitations than the death records. Until 1955 age of the mother was not recorded on the birth certificates that were in use. However, for the years 1948 to 1953 hospital records are available at the Office of Vital Statistics that present data in a measure of detail that is comparable to the U.S. standard registration forms. Sex of the newborn has been recorded on all types of registration forms. Although ethnicity of either parent was not recorded prior to 1955, a close approximation can be arrived at by noticing the reported names of both parents and the four grandparents (in the case of a legitimate livebirth). Considerations of validity run parallel with those for death records but are significantly alleviated by the availability of the earlier mentioned hospital records, which state ethnicity of the mother as well as of the father. For earlier years the coding system that was used provides additional clues of ethnicity: Guam natives who were not U.S. citizens (i.e. Chamorros until 1950) were registered with a person-number. Births registered without such a person-number therefore refer to non-Chamorros.

Since 1955 the three variables that are of importance in the present study, i.e. sex, age of mother and ethnicity of either parent have been uniformly reported, along with many other variables. Of these, two require special mention: reported number of children born to the mother before the most recent birth and the number of these children that have survived up to the date of the most recent birth. These variables seem identical to the CEB and CS that were identified in the census, yet cannot be used in the same way since they have been derived from a different base population.

Reporting of Vital Statistics.

Summarized information, basically identical from the registration records has been published from 1914 to 1922 in the "Guam Newsletter". This publication was

replaced by the "Guam Recorder" which retained the publication of this information almost continuously until the Japanese invasion in December of 1941.

Summaries on the total number of births and deaths occurring during fiscal years have been published in the "Annual reports of the governor of Guam". Change in the definition of "fiscal year" caused some minor discrepancies between these totals. Occasionally, deaths pertaining to the military and civilian population and/or infant deaths were separately presented, but no cross-tabulations of any of the major variables were attempted until after 1970. Since then several useful tabulations for earlier (calendar) years have been made, some of which date back to 1958. Unfortunately, these have not been published. Beginning with calendar year 1970, however, a full scale tabulation program has been published on a yearly basis. For these years many cross-tabulations of vital events by age, sex and/or ethnicity are readily available. Exceptions are "births by race and age of mother", which has been included since 1977 but uses three-year age groups instead of the usual five-year ones, "deaths by race, age and sex" the format of which does not represent a true "three-way" cross-tabulation and "births by race and age of mother and sex of child" which has not been tabulated as yet.

Conclusion.

Both the census and the vital registration system suffer from limited availability of sufficiently detailed demographic data. This is not so much caused by the fact that certain data have not been gathered at all, but must be attributed to the limited extent to which the collected data have been processed and tabulated. The potentially high quality of either registration system is thereby not fully exploited. In the case of the census, for example, the 1970 census report is of such limited value that this census functions as a "bottleneck", prohibiting much of the comparison between past and present that

could otherwise have been made. The absence of any cross-tabulations on vital statistics, made before 1970, is indicative of the changing function of this registration system. Since this system came under the responsibility of a civilian government it has developed from a pure administrative system to a recognized body of data that can be used for various analytical purposes. It is unfortunate that among those purposes demographic analysis has so far largely been neglected, as is evidenced by the absence of certain cross-tabulations and the format of others. Even more so, the wealth of information contained in the registration records prior to 1970 cannot at present be utilized at all, unless one is prepared to work through the individual records, as has been done for the present study.

CHAPTER I - APPRAISAL AND ADJUSTMENT.

Introduction.

In addition to the qualitative assessment of the basic data in the previous chapter several demographic techniques of appraisal can be employed to quantify certain limitations of the basic data. A second step that may be taken on the basis of both qualitative and quantitative appraisal involves adjustment of incomplete or faulty data. One limitation that pervades all subsequent analyses must be pointed out however: the relatively small number of Guam's population serves as a warning that some statistical measures may be subject to a wide range of fluctuations, which may cause difficulties in comparison with other measures. As can be expected, this problem becomes more severe with increasing subdivision of the total population. In many instances in this and subsequent chapters has the calculation of demographic measures therefore been restricted to the aggregate and the Chamorro population. A second limitation is created by the prominence of the factor migration, which distorts many of the measures that are calculated in this report. Appraisal of the quality of data reporting becomes especially difficult under these circumstances, since most methods of appraisal work under the assumption of zero net migration. Closely related to this is a third limitation resulting from the continuously changing numbers of military service personnel and their dependents who, moreover, change residence on average every two years.

Accuracy of Age Reporting.

A method that is generally applicable has been developed under auspices of the United Nations, and is called the United Nations Age-Sex Accuracy Index. This index essentially measures the combined effect of distortions in sex-ratios and deviations from regularity in the age-structure. Under circumstances where real irregularities in age distribution due to migration, war, epidemics and strong fluctuations in births and deaths are negligible this index provides a general measure of net age misreporting. Although the index is subject to some bias, it is useful for comparative purposes. Table I.1 presents such comparison. Usually this measure varies between zero (perfect reporting with no external influences) and about 100. This index as applied to the Philippine census of 1960 measures 32.8; the census of the United States in 1960 results in a value of 12.2. In the case of Guam the above mentioned circumstances are only applicable to the Chamorro population in the period of about 20 years before and after World War II. For other population groups the index does not measure net age misreporting but rather deviations in population structure that are mainly due to migration. Table I.1 presents the values of the index for the Chamorro and aggregate population. As can be observed in table I.1, the distortions after World War II have gradually become less pronounced.

The main advantage of the above method lies in the fact that it can be used when a tabulation of the population by five-year age groups and sex is available, which is usually the case. When a tabulation by single years of age is available several methods for measuring the extent to which age reporting has been subject to preference for certain terminal digits can be employed. Of these, Myer's blended index is preferable because of its limited sensitivity to distortions from other sources and its ease of calculation. The index is able to demonstrate preference or avoidance of terminal digits in answers to a question like "How old

TABLE I.1
UNITED NATIONS AGE-SEX ACCURACY INDEX.
GUAM, 1940-1980.

YEAR	CHAMORRO		AGGREGATE	
	INDEX	NUMBER	INDEX	NUMBER
1,940	36.63	20,177	35.06	22,290
1,950	41.25	27,124	230.39	59,498
1,960	36.98	34,762	101.28	67,044
1,970	*	42,532	88.62	84,996
1,980	*	47,845	47.95	105,979

Note:
* Not available

TABLE I.2
EVALUATION OF CENSUS COVERAGE AND DEATH REGISTRATION.
CHAMORRO POPULATION, GUAM 1930-1960.

	METHOD	YEAR 1930	1940	1950	1960
MALES	LIN.REGR.	106.16%	105.90%	78.64%	61.64%
	ROBUST M.	120.30%	110.00%	91.14%	174.45%
FEMALES	LIN.REGR.	92.51%	116.41%	72.23%	66.03%
	ROBUST M.	124.79%	116.89%	75.00%	84.80%

are you?". When instead a question is asked that inquires after a person's date of birth digital preference may occur according to the reported year of birth when the exact date of birth is not known. As mentioned in an earlier paragraph, the latter type of question has been asked in censuses on Guam since 1960. The summary value of Myer's blended index for both sexes combined in the 1980 census amounts to a mere 1.37, with no individual digit showing substantial deviation. Since this index theoretically can vary between 0 and 90, with the latter value indicating absolute preference for one particular terminal digit, the present value can be taken to represent only random fluctuations. This means that the date of birth has generally been correctly reported in this census.

Stability.

Several methods of appraisal have been developed that rely on the assumption that the population has not been subject to influences such as migration, war etc. The consequences of not meeting this assumption could be noted in the case of the U.N. index, discussed above. Since in the following several methods will be employed that are also based on this assumption it seems appropriate at this point to introduce the concept of "stable population". A population has become stable when (age-specific) birth and death rates have remained constant, no migration has occurred and no major disasters have taken place for a long period of time, which varies with the original characteristics of the population. These circumstances ultimately result in a fixed age distribution and a constant, so-called "intrinsic" rate of natural increase. Projection series 4 in chapter VI illustrates such development.

Under the assumption of stability, life expectancy at birth can be estimated by analyzing tabulated age distributions from two successive censuses. Survivorship rates for each cohort, in combination with an appropriate model life table, result in a series of life expectancy values that should remain within close limits if the assumption of stability were justified. Consequently, departure from stability is indicated by the range of these values.

Figures I.1 a,b and c show the results of this technique, as applied to the Chamorro population, the only population group that can reasonably be expected to approximate a stable population. From these figures it can be concluded that Chamorro females generally have more stable age distributions than Chamorro males, but that both groups show serious distortions, occurring between 1950 and 1960. Apparently the assumption of stability no longer holds for this decade. Declining fertility as well as the onset of outmigration among Chamorros and Caucasians may largely account for the observed distortions.

Cohort Survivorship Rates (CSR) can also be employed in a more direct way to indicate distortions from causes other than changes in fertility. Ideally, these rates should fall fairly smoothly as age increases, females showing the same pattern as males, but on a higher level. CSRs greater than 1.000 can only be explained by reporting errors or net inmigration of persons in the population group under consideration. Figures I.2 a-e show CSRs for the Chamorro as well as the aggregate population of Guam. As far as the Chamorros is concerned, the patterns of deviation closely resemble the results of the stable population analysis, as can be expected. Attention is drawn to the few values over 1.000 that show for the decade 1940-1950. It seems unlikely that these are caused by net inmigration, since this decade witnessed the onset of outmigration of Chamorro people, as the chapter on migration will show. Misreporting of age and differential classification into ethnic groups between the census of 1940 and the one of 1950 may therefore largely account for these distortions. The values for

FIGURE I.1 (a)

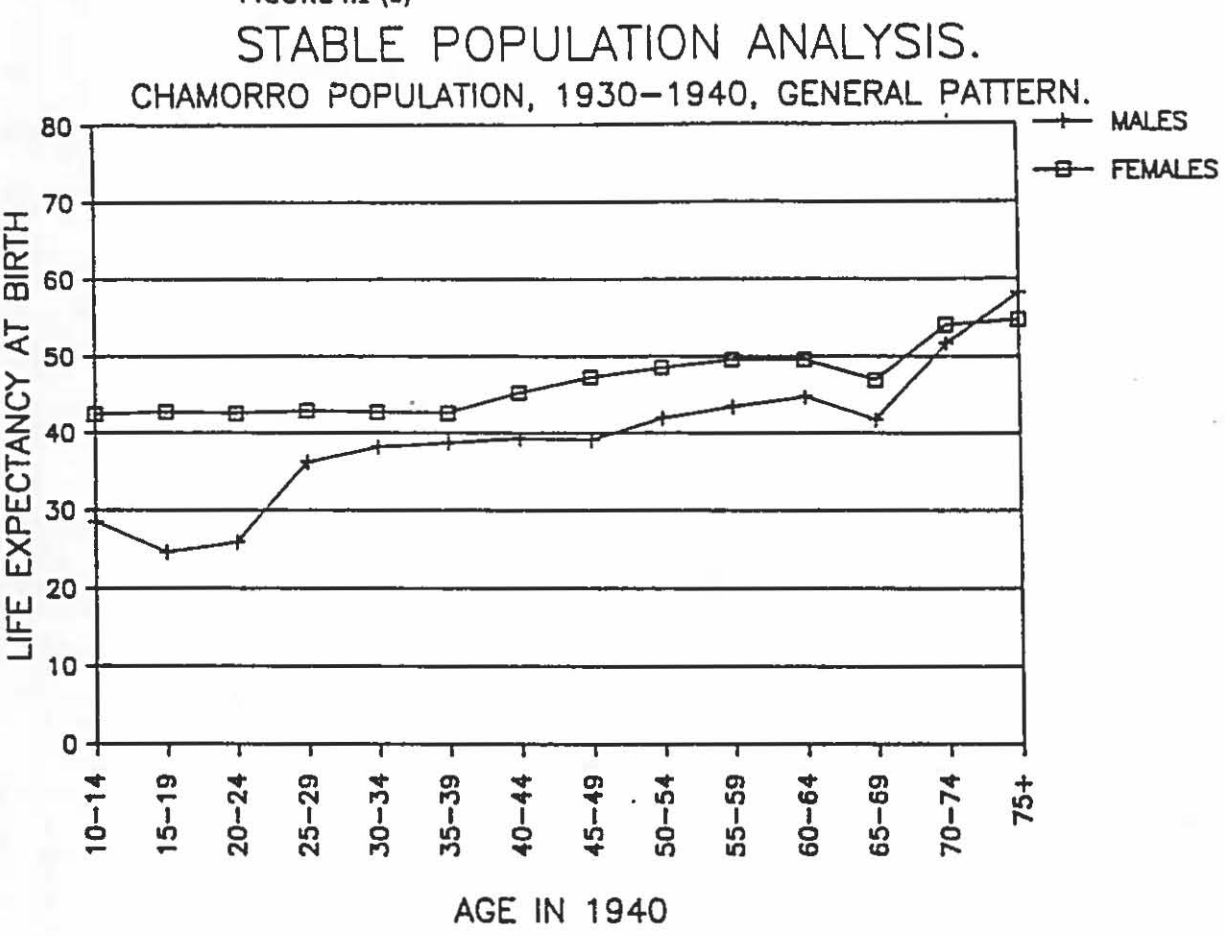


FIGURE I.1 (b)

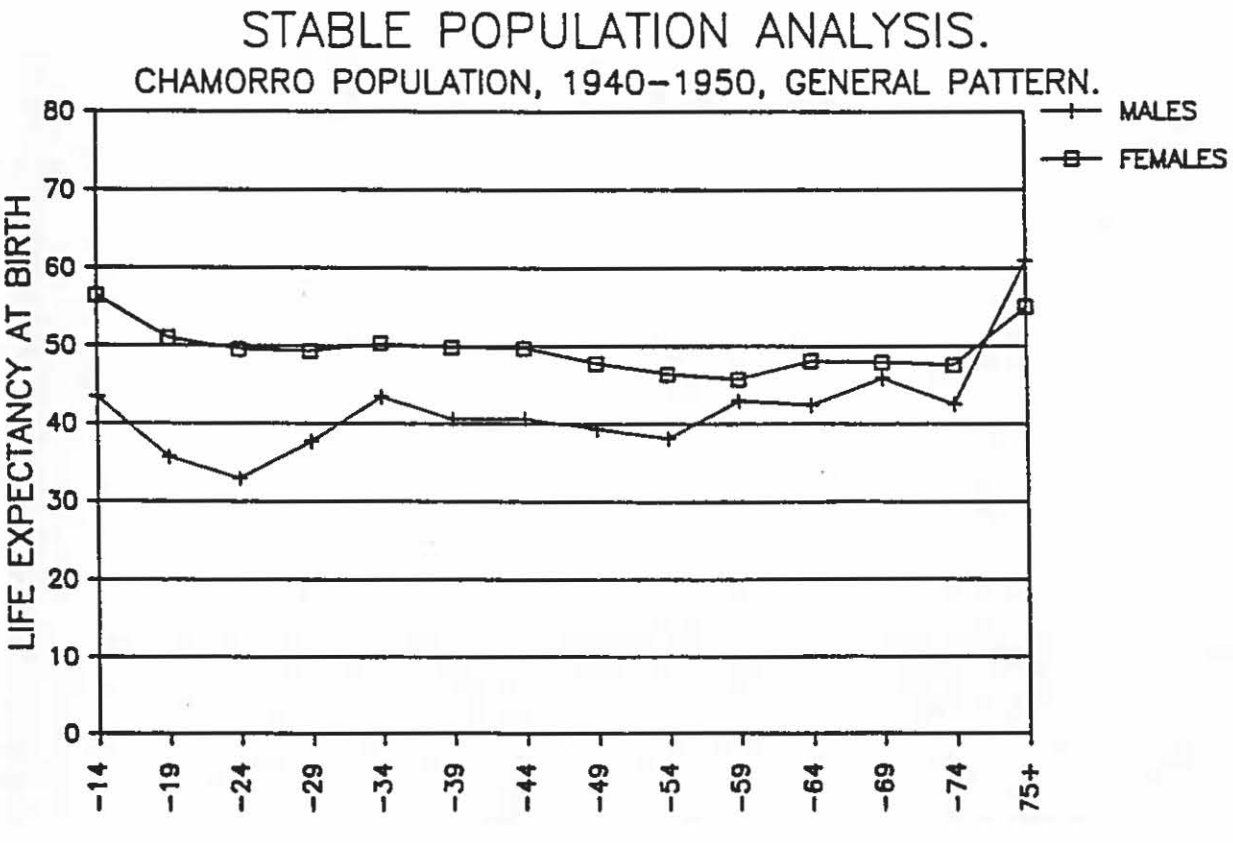


FIGURE I.1 (c)

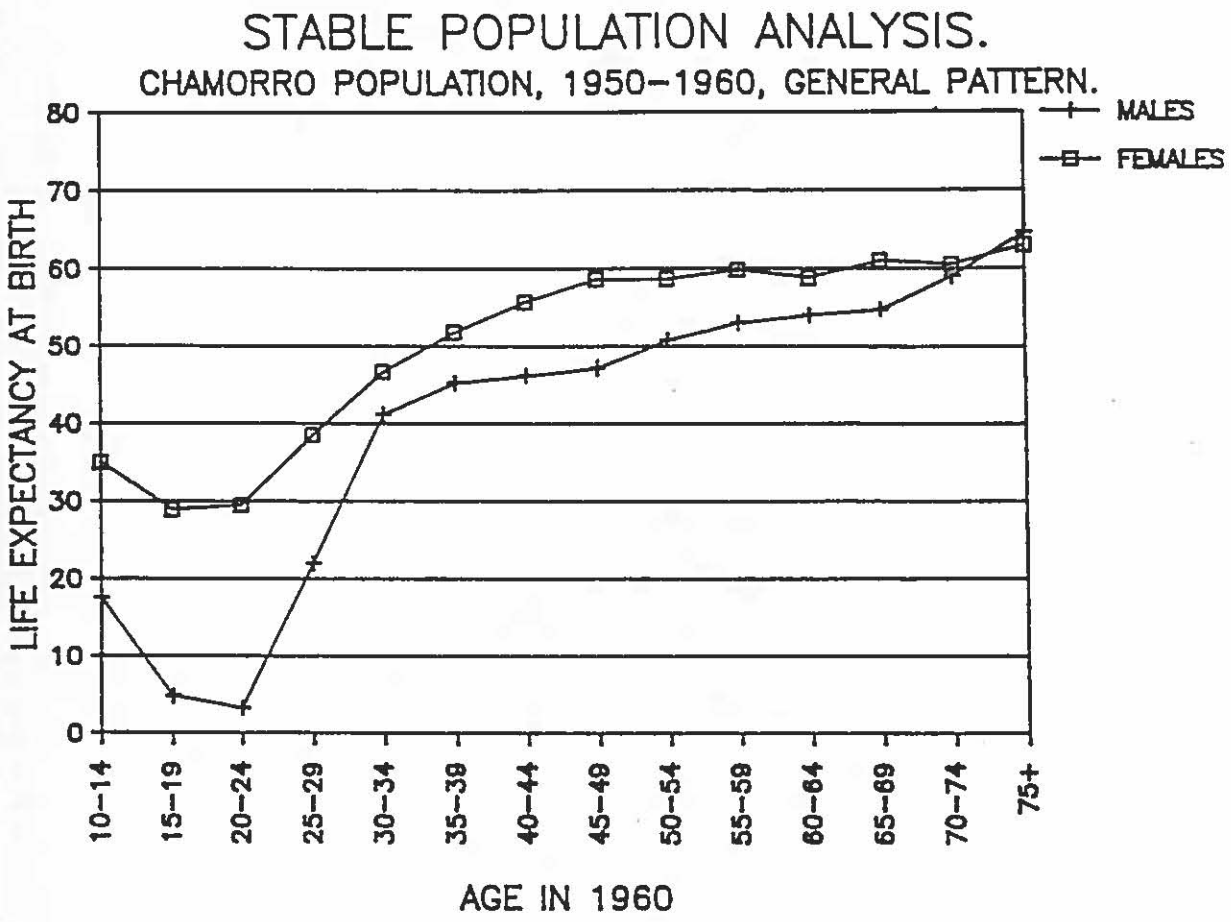

STABLE POPULATION ANALYSIS.
CHAMORRO POPULATION, 1950–1960, GENERAL PATTERN.
MALES
FEMALES
LIFE EXPECTANCY AT BIRTH
80
70
60
50
40
30
20
10
0
10–14
15–19
20–24
25–29
30–34
35–39
40–44
45–49
50–54
55–59
60–64
65–69
70–74
75+
AGE IN 1960

FIGURE I.2 (a)

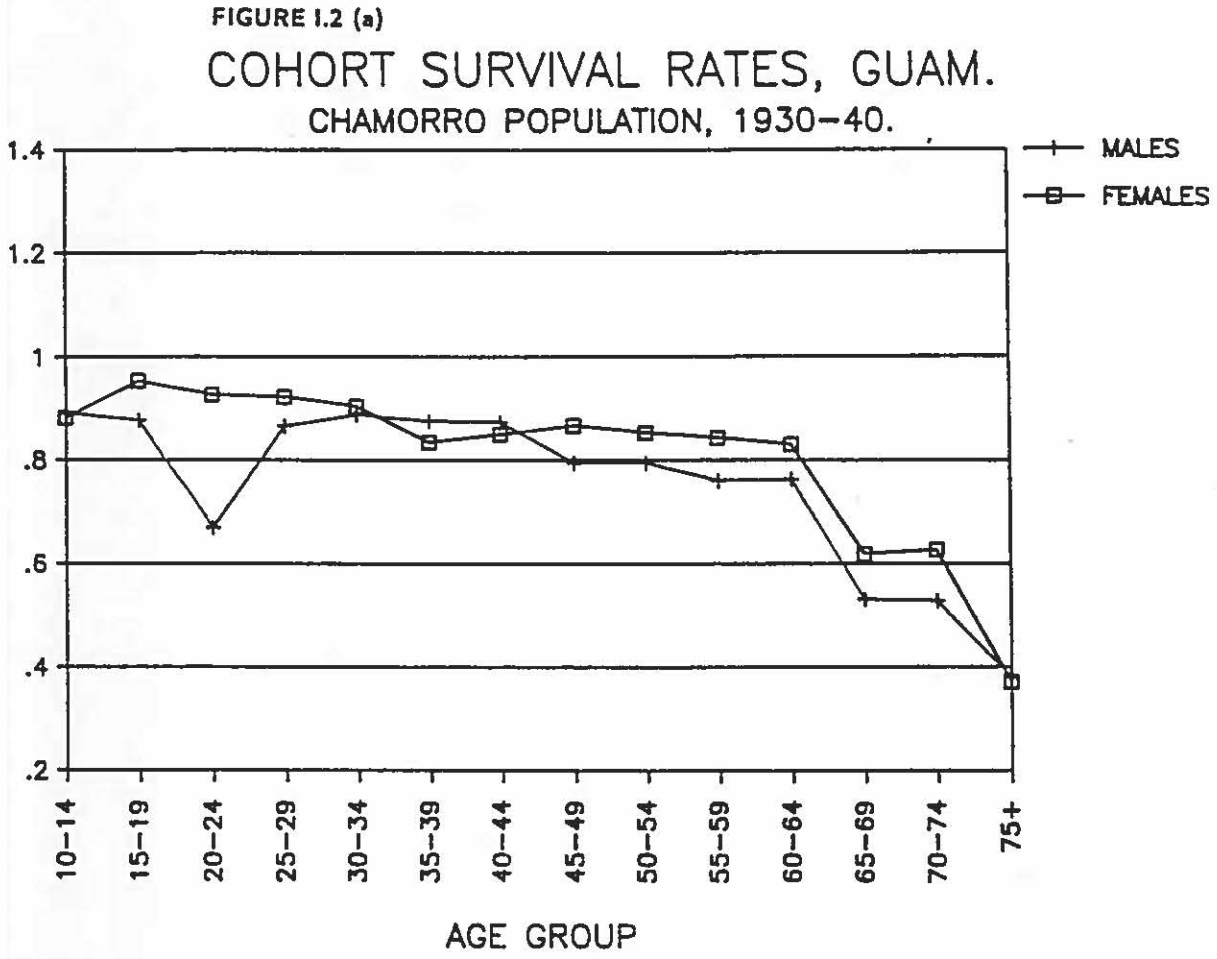


FIGURE I.2 (b)

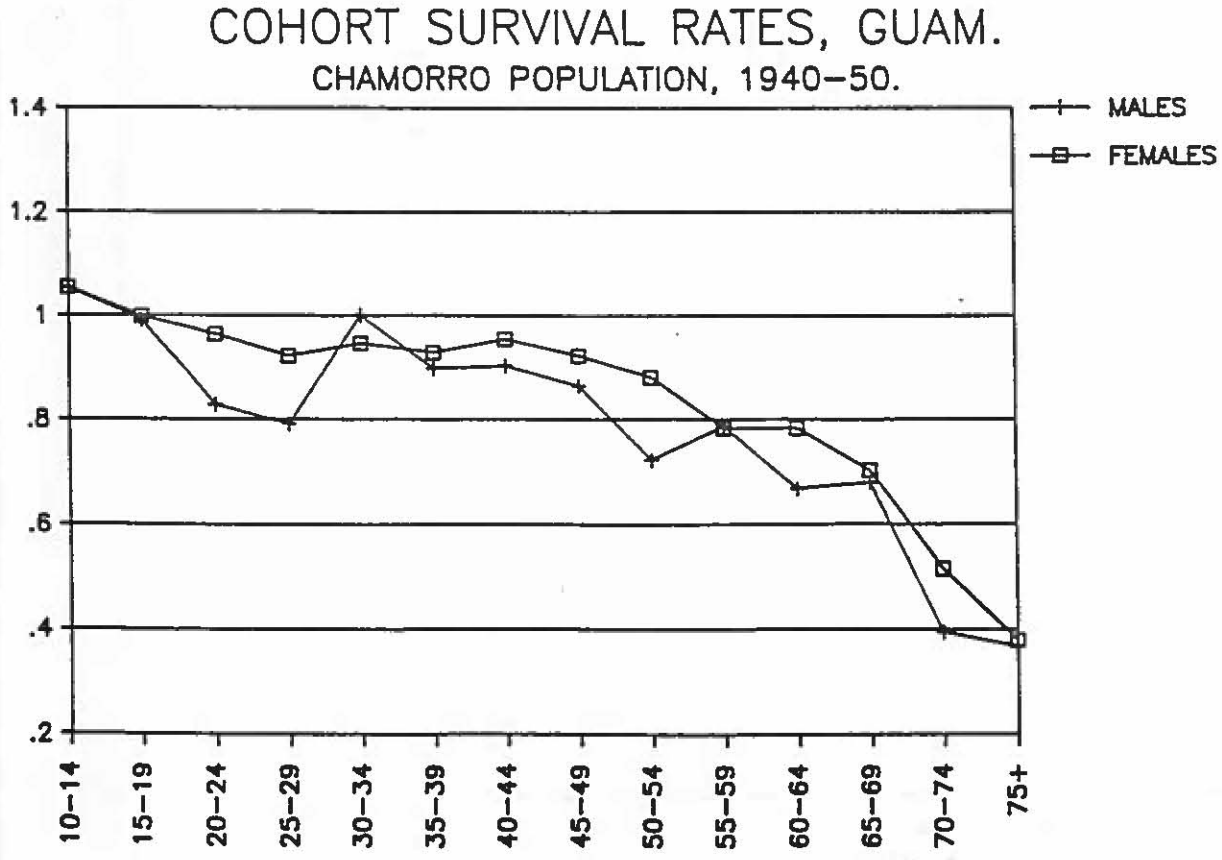


FIGURE I.2 (c)

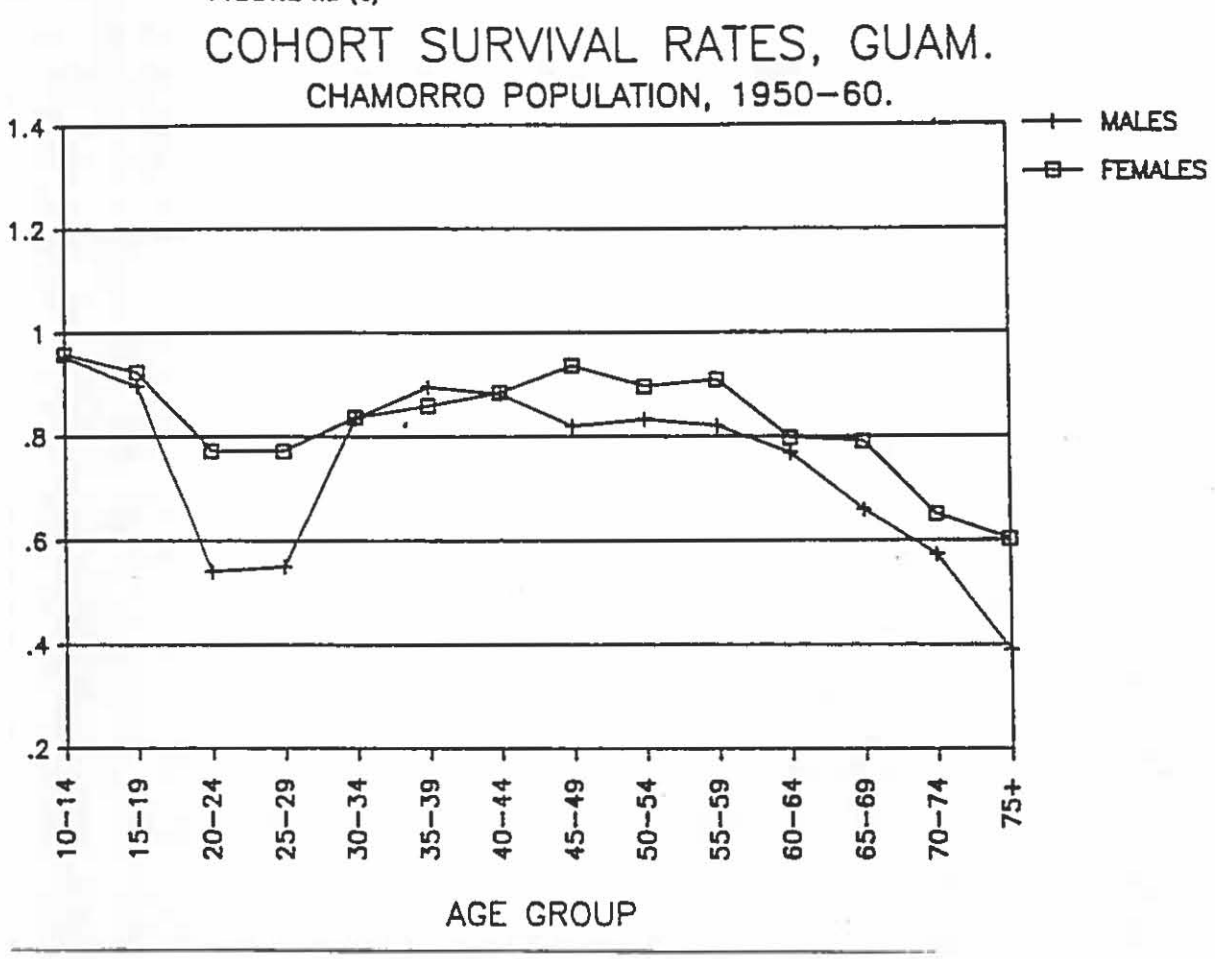


FIGURE I.2 (d)

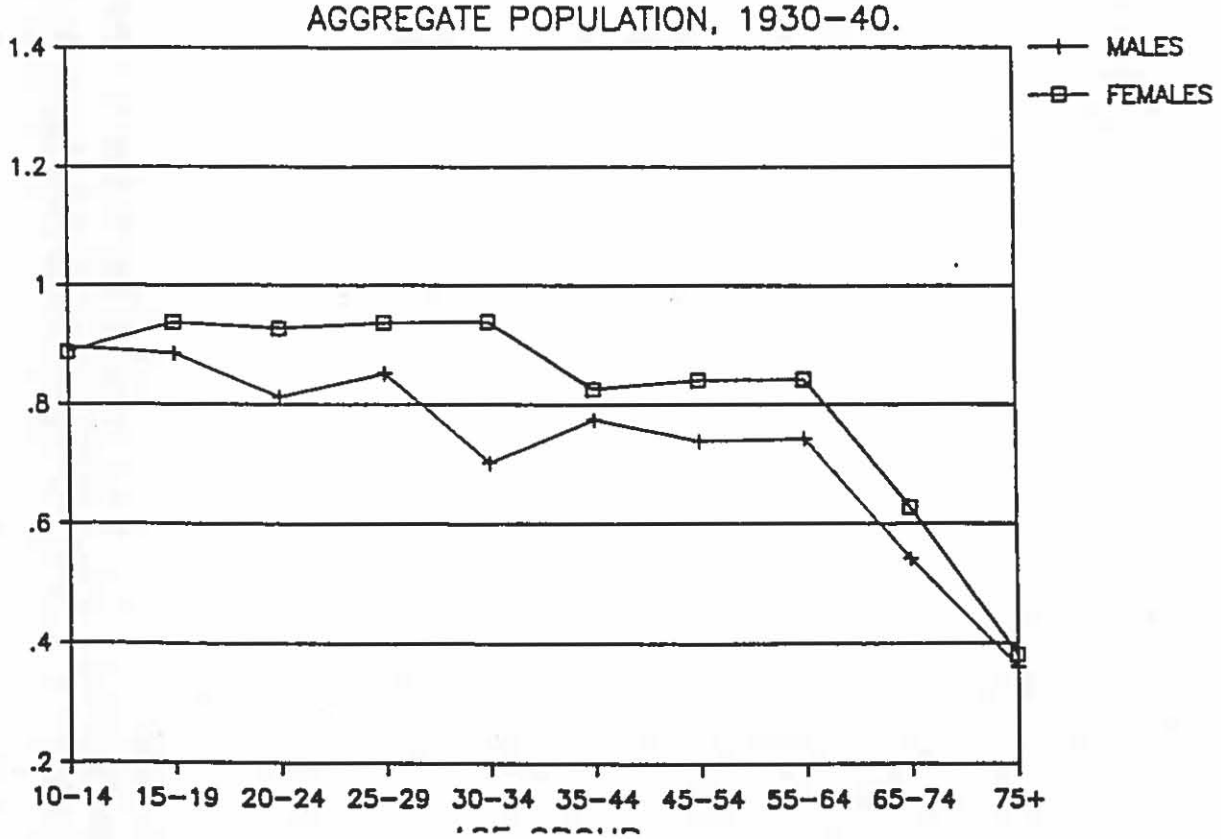
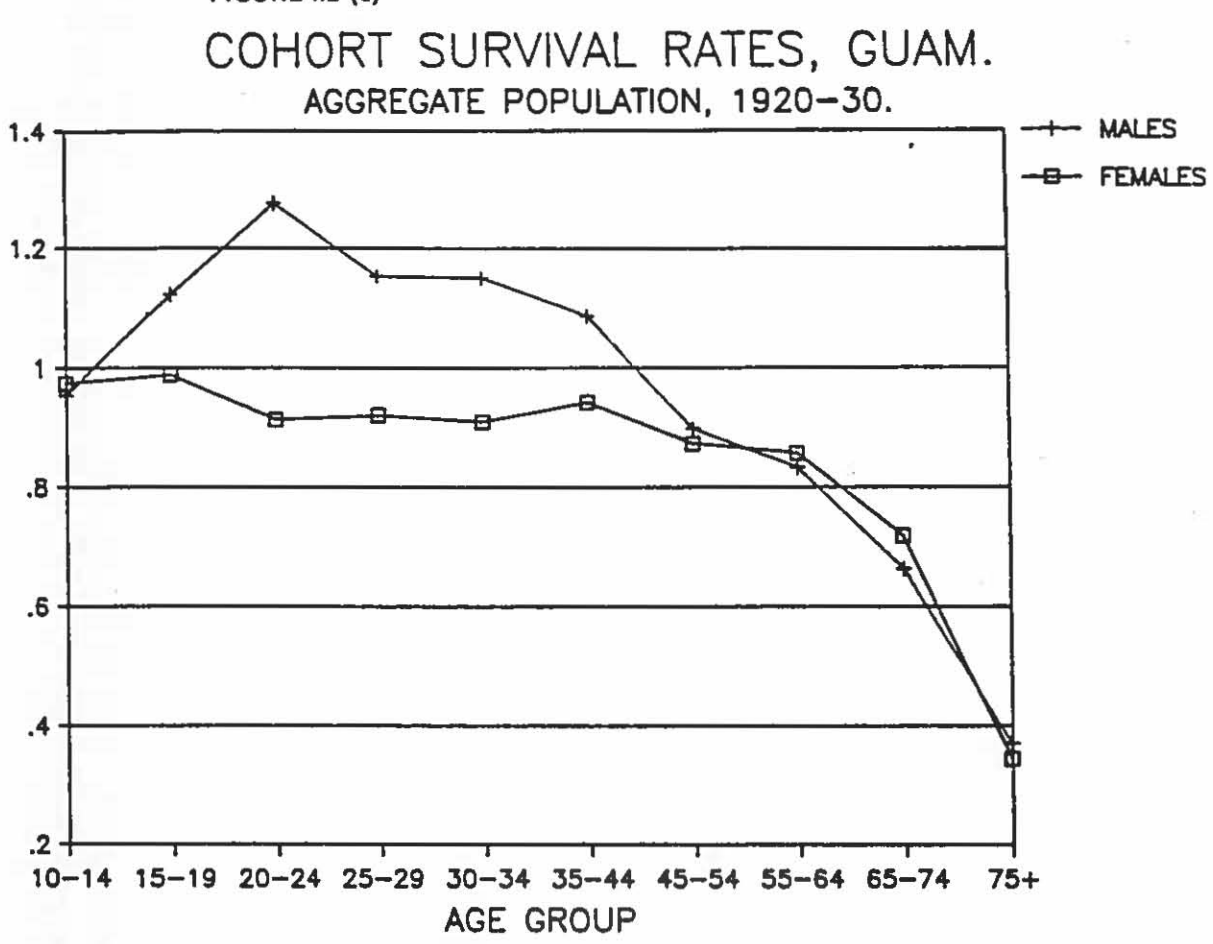


FIGURE I.2 (e)


COHORT SURVIVAL RATES, GUAM.
AGGREGATE POPULATION, 1920–30.
MALES
FEMALES
1.4
1.2
1
.8
.6
.4
.2
10–14
15–19
20–24
25–29
30–34
35–44
45–54
55–64
65–74
75+
AGE GROUP

the aggregate population reflect patterns of migration that did occur. The values over 1.000 between 1920 and 1930 are to be attributed to net inmigration of males between the ages of 15 and 50. They therefore do not represent true cohort measures and have merely been plotted for purposes of comparison.

Census and Vital Registration.

So far, only checks of internal consistency of the census registration have been made. As noted earlier however, Guam is fortunate in having a vital registration system. This greatly improves the possibilities for evaluation since both systems obtain their data from the same population, independently provide data to derive the same type of measures, yet employ different methods in doing so. Utilizing empirically derived relationships between certain types of rates and between these and the base population they have been abstracted from, vital registration can be matched with census registration. Under the assumption that overregistration is less likely than underregistration, inferences can be made as to the relative completeness of either registration system.

Several interesting examples of the above principle have been developed by William Brass. One basically very simple method focuses on the evaluation of death registration versus a reported age distribution.

This method effectively indicates the percentage by which the reported number of deaths needs to be increased or decreased in order to arrive at the amount of deaths that would be expected, given the reported age distribution and under the assumption that the population is stable. Table I.2 presents the resulting percent completeness of the death registration relative to completeness of the census enumeration. Results over 100% can be explained by assuming that overregistration of vital events is unlikely, and that the surplus of 100% is therefore indicative of the minimal amount of census underenumeration. Each

FIGURE I.7

AGE SPECIFIC FERTILITY RATES, GUAM 1980.

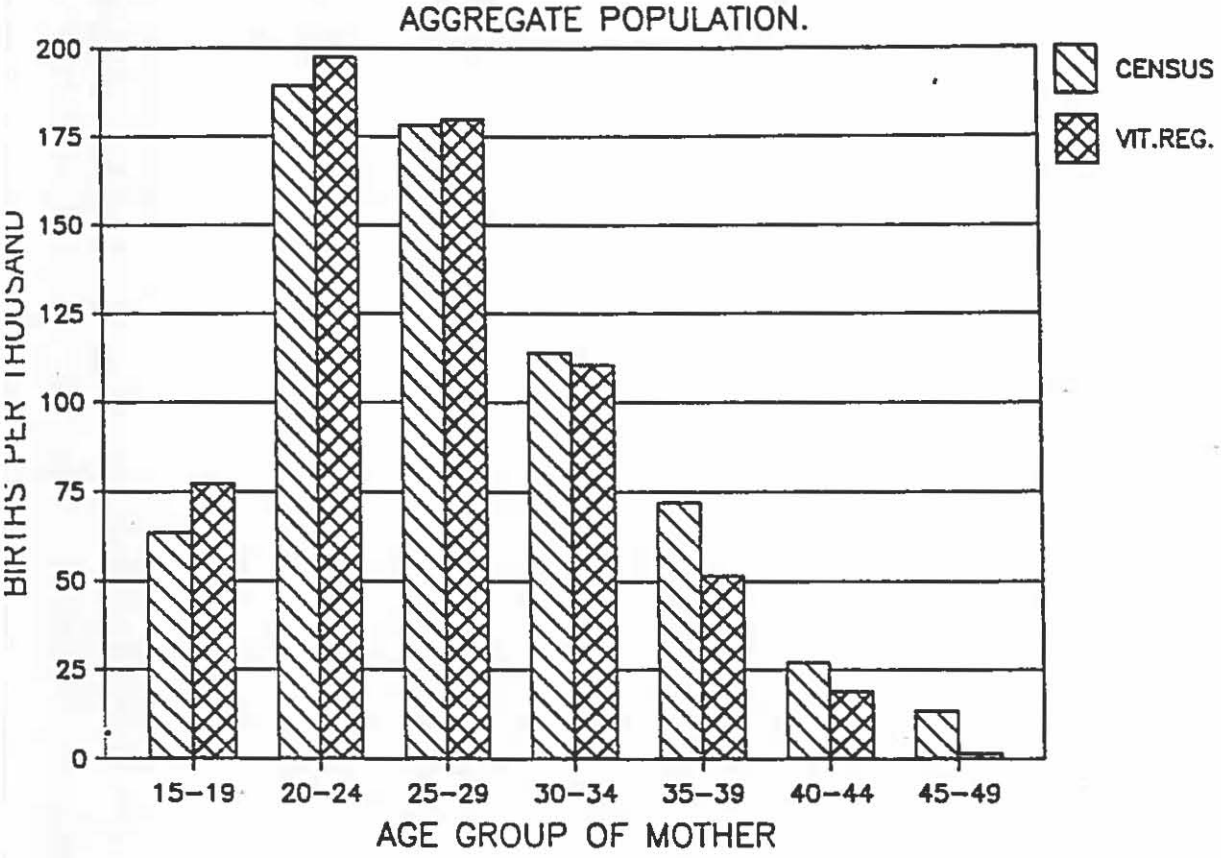


FIGURE I.5

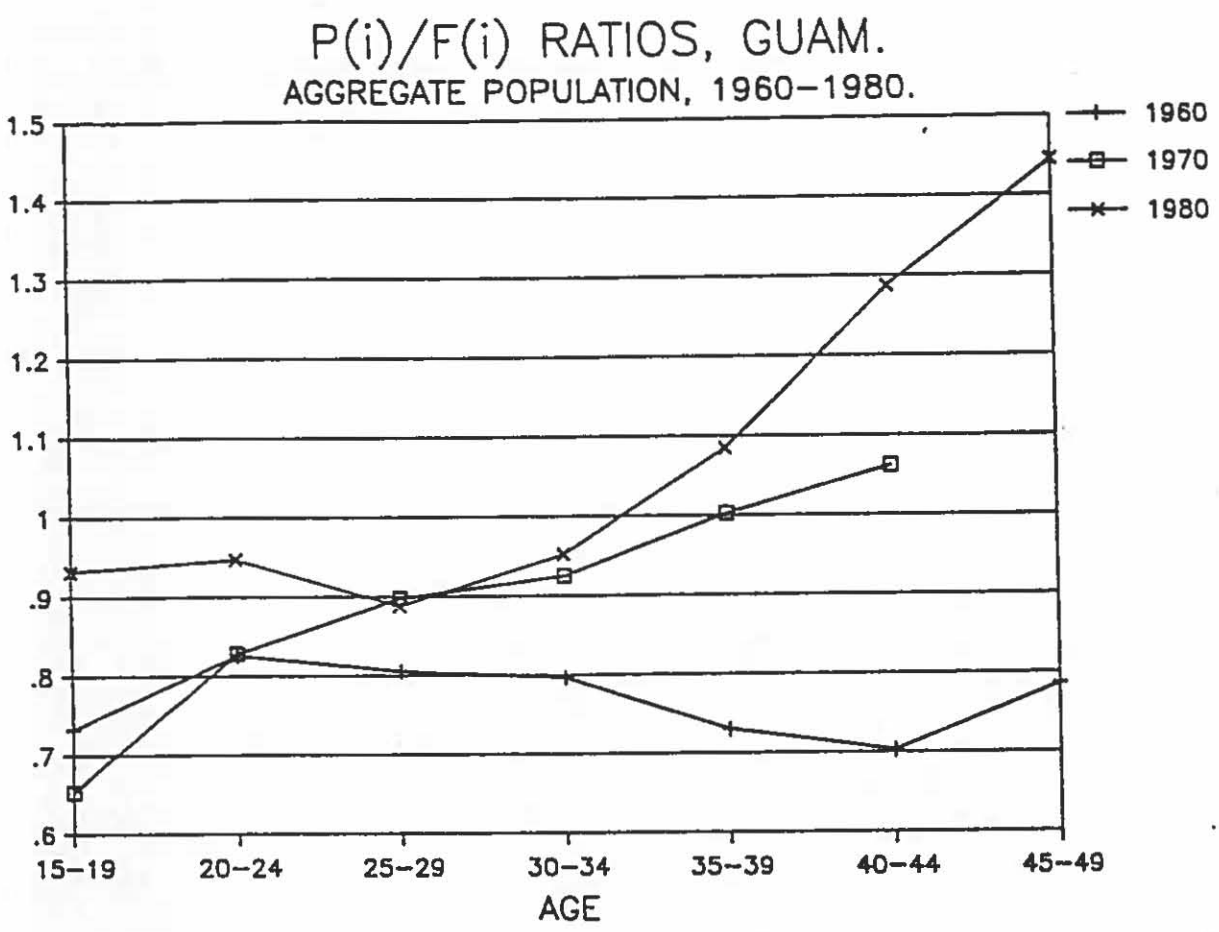
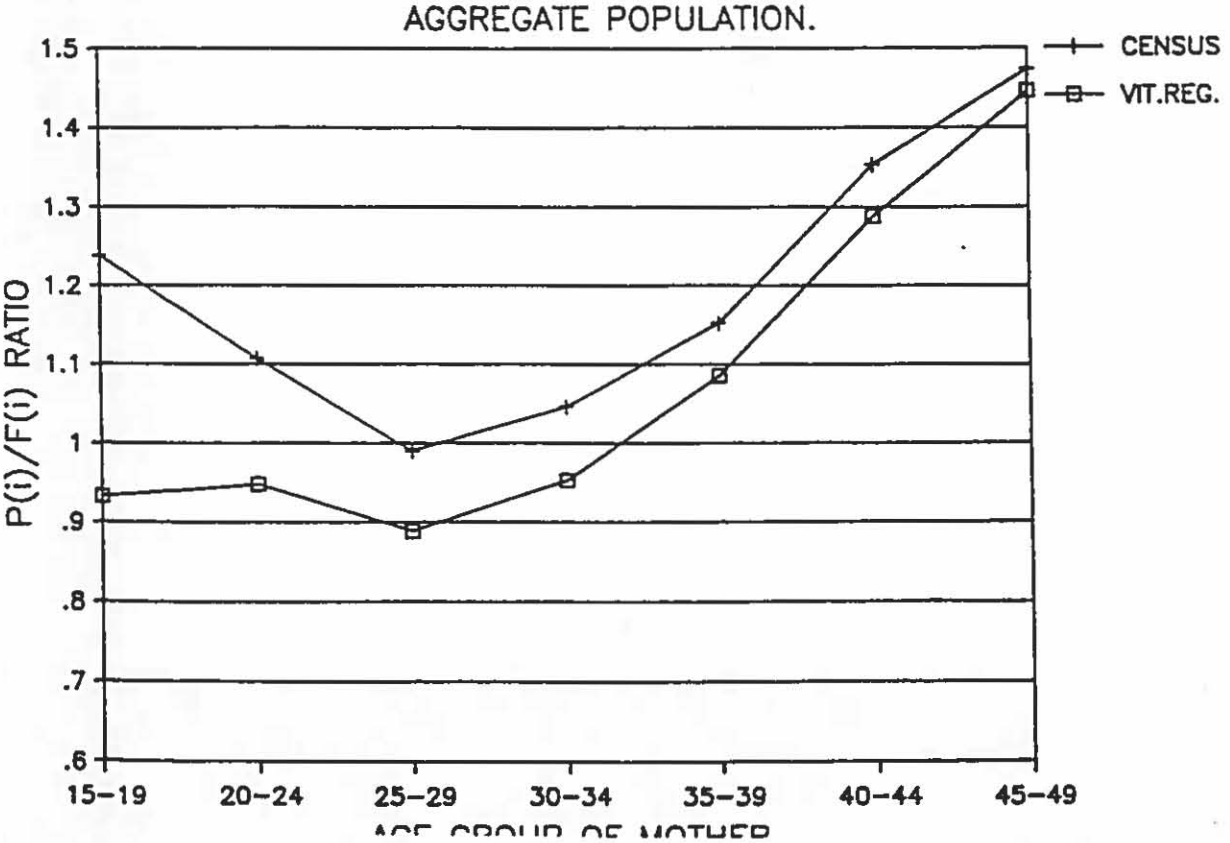


FIGURE I.6



2.4, implying an underreporting of CEB who have died of 70%, or overreporting of CS of this magnitude. This is in agreement with the results from Feeney's method, eliminating the choice of model life table as cause for the discrepancy. Past experience with reporting of these two variables in other countries suggests that the present situation may result from underreporting of CEB who have died, especially those who died at very young ages. This is the most likely explanation for the observed relative overreporting of the variable CS.

Parity information (CEB) can be directly compared to reported fertility during the year before the census as recorded in the vital registration system and/or the census. In this way values from a cross-section of time (period measures), F(i), are compared to values generated through time (cohort measures), P(i). Given complete reporting and constant fertility the ratio between two series of either measures should be constant, around unity. Under circumstances of a decline in fertility these ratios will increase with increasing age. A decrease in ratios for older age groups typically indicates underreporting of CEB by older women. In figure I.5 the denominator, F(i), has been constructed from data on reported fertility from the vital registration system. The curve formed by P(i)/F(i) ratios for 1960 in figure I.5 shows neither of the above patterns; the ratios are fairly constant, but way below unity. Bearing in mind that the basic data on CEB in the 1960 census has been derived only from women ever married, it can be inferred that this procedure has resulted in underreporting of this information for all age groups. Again, however, there are some other factors involved that result in additional distortion: World War II, during which less childbirth took place, and migration, adding women with less-than-average (legal) childbirth to Guam's population. Both factors would result in lower numbers of CEB, at least for older women. The 1970 values start on a similar level, but gradually increase to above unity. This is a clear indication of a decline in fertility. The low starting values imply a similar level of underreporting as in

Griffith Feeney uses the same variables to estimate values for infant mortality up to about 15 years prior to the census without the use of a vital registration system. These can be compared to Infant Mortality Rates referring to the same exact points in time, derived from the vital registration. This method generates a value for the Mean Age at Childbearing as a by-product, which, in the case of the 1980 census, is estimated as 28.3. Figure I.4 presents the two series of values. The serious dissimilarity of these timeseries may serve as a repeated indication that either the "West" model life table is inappropriate, the number of CEB has been understated or the number of CS has been overstated in the census of 1980.

A third method developed by Brass also uses data on Children Ever Born and Children Surviving in order to estimate the expected number of births up to 10 years prior to the census. These, of course, are to be compared to the number of births that has been registered by the vital registration system. This is being accomplished by projecting the number of individuals of age 0 to 9 at the time of the census backwards to the year in which they were born. However, this final step is largely rendered irrelevant through the strong influence of migration, which has caused the reported numbers of children at ages 0 through 9 to fluctuate in a suspicious manner. Instead, an intermediate step that is being taken in this method bears significance as to the observations and inferences that were made from the previous two methods. In this step the proportion of CEB that has died is compared with similar values from an empirically derived standard. The two series are placed in a linearized relationship through the so-called "logit" transformation. Through the same reasoning as Brass employed in his evaluation of death registration, regression of the two series results in a value for the slope of the "best fit" line through the points in a scattergram. This value minus one represents the multiplier, needed to convert the reported proportion dead to the level of the standard. The 1980 data result in a slope of

FIGURE I.3

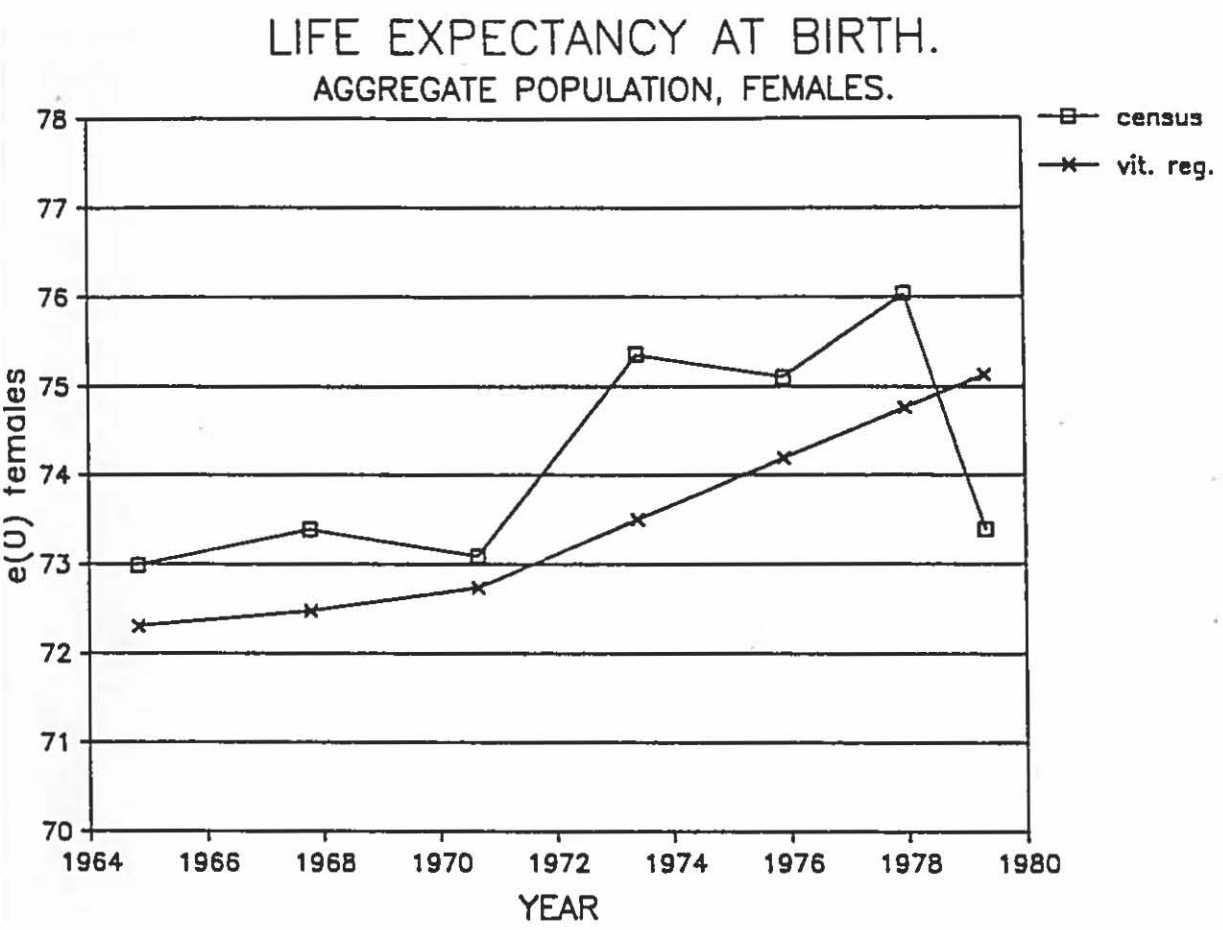
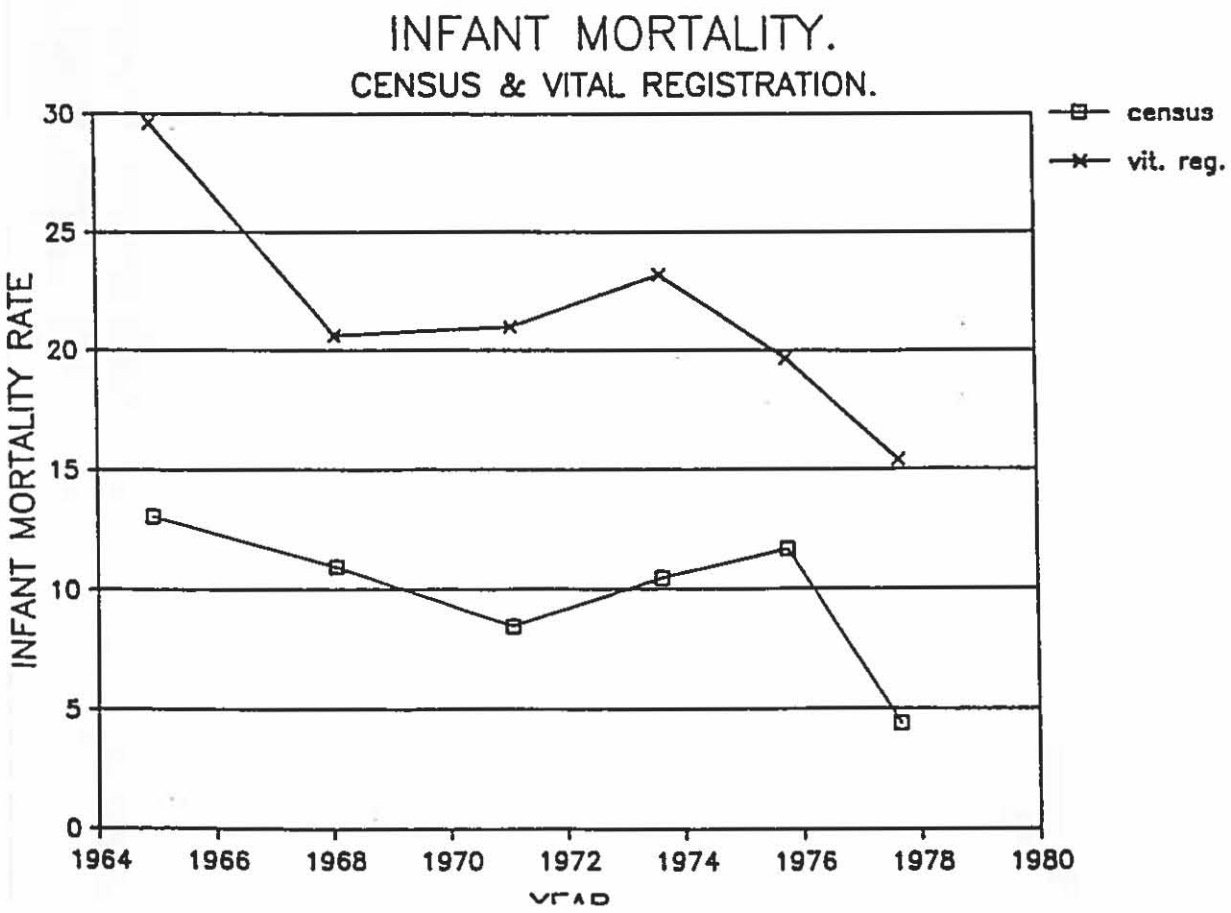


FIGURE I.4



estimate has been arrived at in two ways; through linear regression and through a so-called "robust" method. Robustness in demographic terminology essentially means that the results of the method will not be influenced when the implied assumptions of the method are not entirely met in reality. In the present method this applies to the assumption of stability of the population. From table I.2 it can be concluded that between 1930 and 1950 the census coverage has become more complete, while the death registration deteriorated between 1940 and 1950. For the Chamorro males in 1960 the departure from stability is evident, and is reflected in large discrepancies between estimates based on linear regression and those based on the robust method. Migration may largely account for these distortions since the results for females (who experience less migration than males, see chapter V) are generally better than for males. It must be concluded that the departures are of such magnitude that even the robust estimates are severely biased.

Another method developed by Brass is based on the variables Children Ever Born (CEB) and Children Surviving (CS) by age of mother. These can be converted to measures of childhood mortality and associated life expectancy at birth referring to various points in time up to about 15 - years prior to the census. These measures can be compared to analogous ones derived from earlier censuses by means of interpolation. In figure I.3 values for life expectancy at birth are plotted that have been derived from the 1980 census through the use of a "West" model life table. This figure also shows interpolated values from censuses and vital registration since 1960. Although the discrepancy is not extreme, it is large enough to suggest either inappropriateness of the employed family of life tables, underreporting of CEB or overreporting of CS, especially in the younger age groups. As is suggested by Brass, the very first value should be ignored, since reporting of mothers aged 15-19 is usually unsatisfactory.

Griffith Feeney uses the same variables to estimate values for infant mortality up to about 15 years prior to the census without the use of a vital registration system. These can be compared to Infant Mortality Rates referring to the same exact points in time, derived from the vital registration. This method generates a value for the Mean Age at Childbearing as a by-product, which, in the case of the 1980 census, is estimated as 28.3. Figure I.4 presents the two series of values. The serious dissimilarity of these timeseries may serve as a repeated indication that either the "West" model life table is inappropriate, the number of CEB has been understated or the number of CS has been overstated in the census of 1980.

A third method developed by Brass also uses data on Children Ever Born and Children Surviving in order to estimate the expected number of births up to 10 years prior to the census. These, of course, are to be compared to the number of births that has been registered by the vital registration system. This is being accomplished by projecting the number of individuals of age 0 to 9 at the time of the census backwards to the year in which they were born. However, this final step is largely rendered irrelevant through the strong influence of migration, which has caused the reported numbers of children at ages 0 through 9 to fluctuate in a suspicious manner. Instead, an intermediate step that is being taken in this method bears significance as to the observations and inferences that were made from the previous two methods. In this step the proportion of CEB that has died is compared with similar values from an empirically derived standard. The two series are placed in a linearized relationship through the so-called "logit" transformation. Through the same reasoning as Brass employed in his evaluation of death registration, regression of the two series results in a value for the slope of the "best fit" line through the points in a scattergram. This value minus one represents the multiplier, needed to convert the reported proportion dead to the level of the standard. The 1980 data result in a slope of

2.4, implying an underreporting of CEB who have died of 70%, or overreporting of CS of this magnitude. This is in agreement with the results from Feeney's method, eliminating the choice of model life table as cause for the discrepancy. Past experience with reporting of these two variables in other countries suggests that the present situation may result from underreporting of CEB who have died, especially those who died at very young ages. This is the most likely explanation for the observed relative overreporting of the variable CS.

Parity information (CEB) can be directly compared to reported fertility during the year before the census as recorded in the vital registration system and/or the census. In this way values from a cross-section of time (period measures), F(i), are compared to values generated through time (cohort measures), P(i). Given complete reporting and constant fertility the ratio between two series of either measures should be constant, around unity. Under circumstances of a decline in fertility these ratios will increase with increasing age. A decrease in ratios for older age groups typically indicates underreporting of CEB by older women. In figure I.5 the denominator, F(i), has been constructed from data on reported fertility from the vital registration system. The curve formed by P(i)/F(i) ratios for 1960 in figure I.5 shows neither of the above patterns; the ratios are fairly constant, but way below unity. Bearing in mind that the basic data on CEB in the 1960 census has been derived only from women ever married, it can be inferred that this procedure has resulted in underreporting of this information for all age groups. Again, however, there are some other factors involved that result in additional distortion: World War II, during which less childbirth took place, and migration, adding women with less-than-average (legal) childbirth to Guam's population. Both factors would result in lower numbers of CEB, at least for older women. The 1970 values start on a similar level, but gradually increase to above unity. This is a clear indication of a decline in fertility. The low starting values imply a similar level of underreporting as in

FIGURE I.5

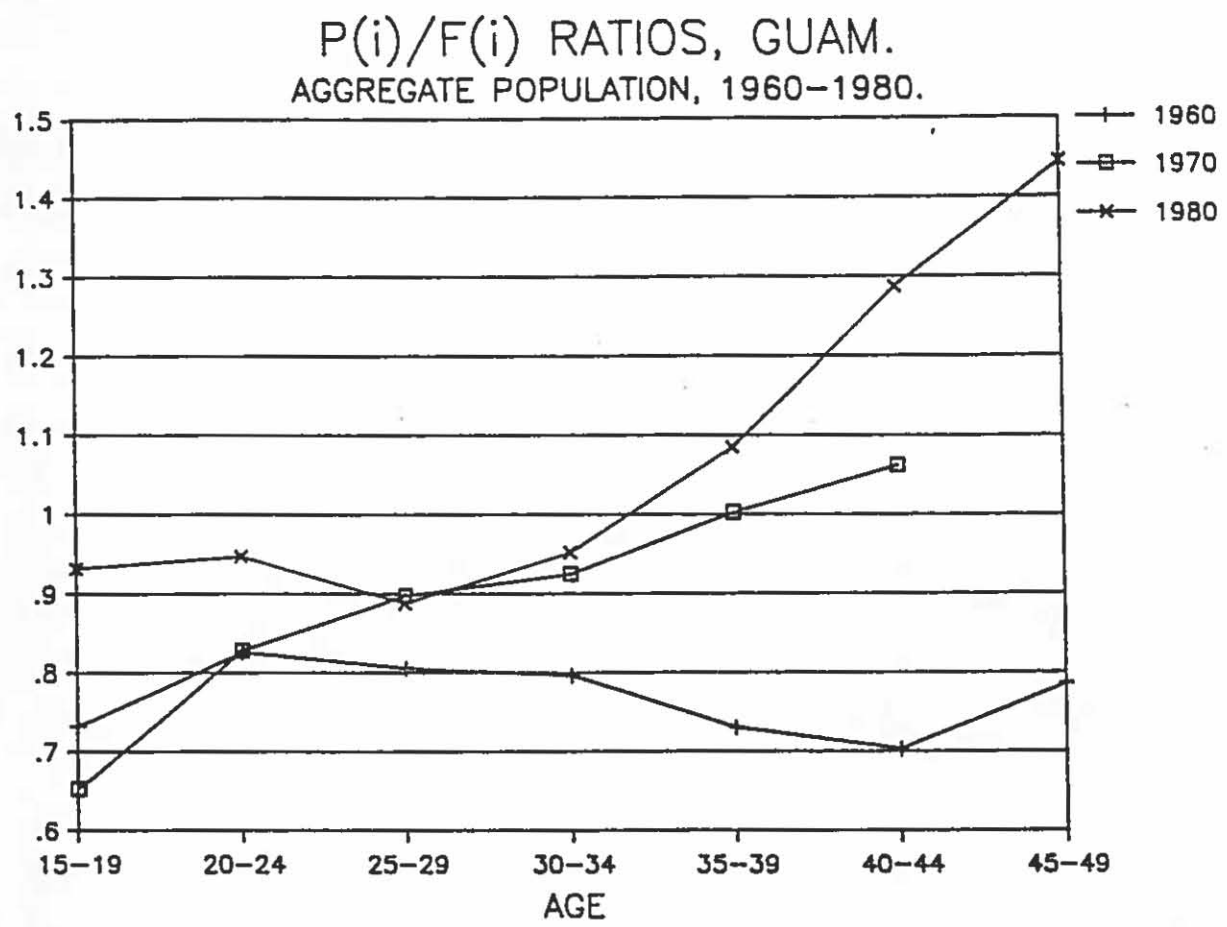


FIGURE I.6

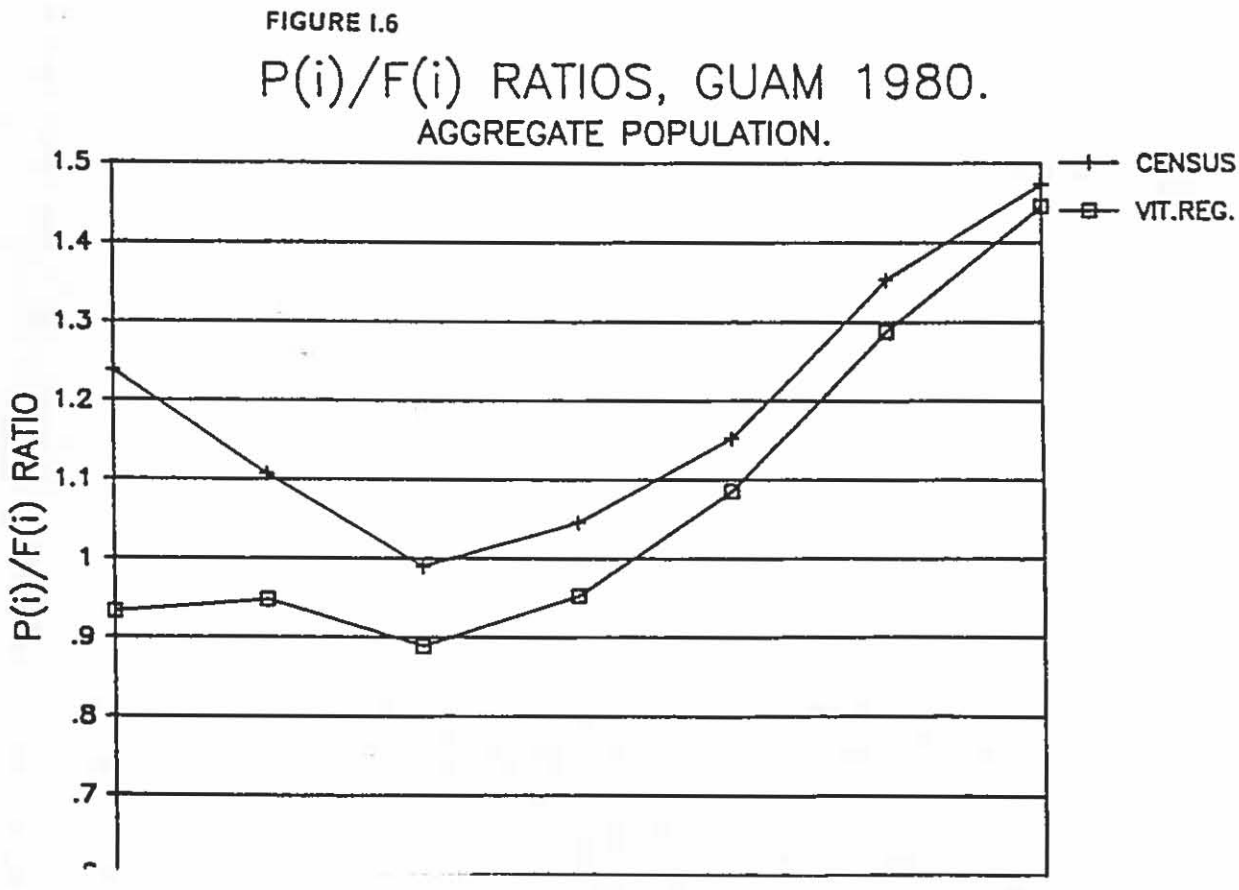
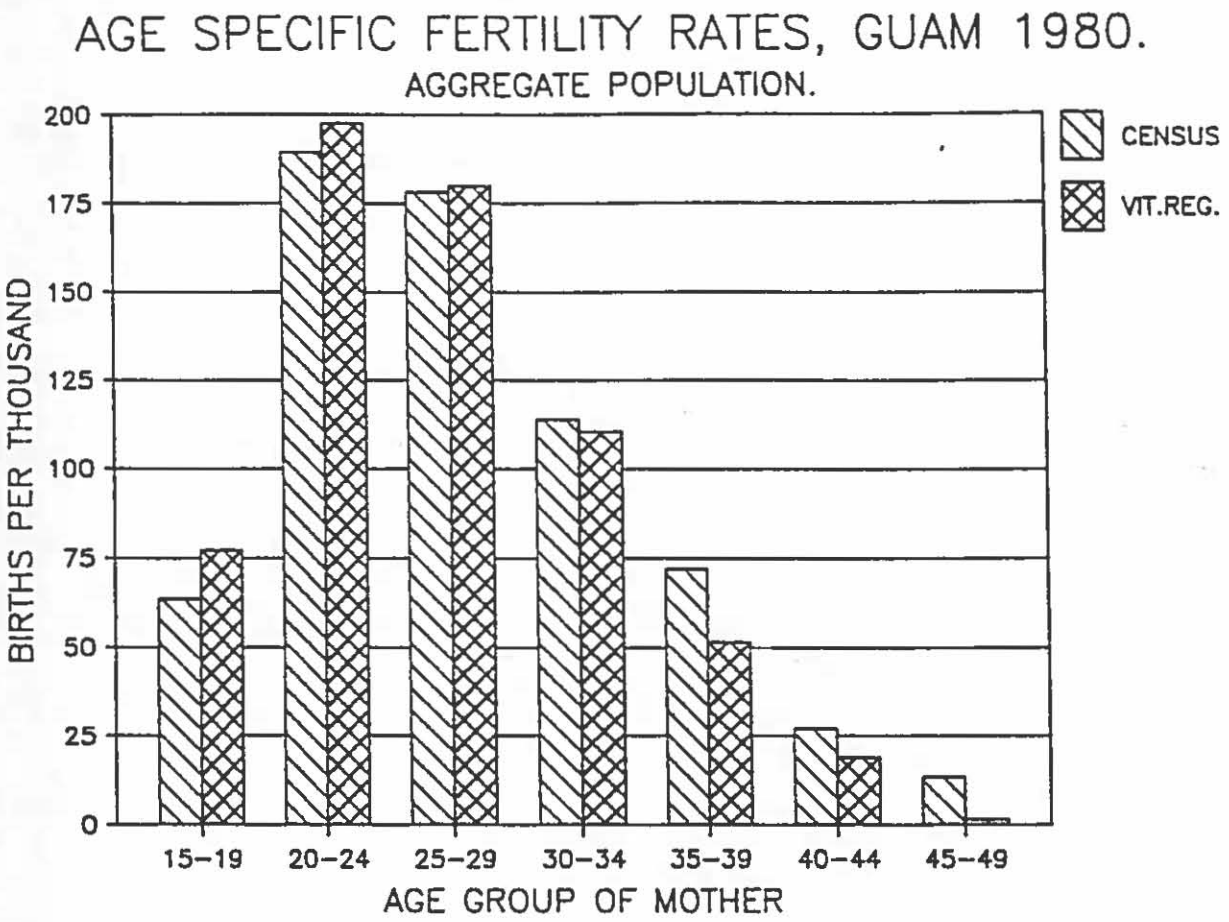


FIGURE I.7


AGE SPECIFIC FERTILITY RATES, GUAM 1980.
AGGREGATE POPULATION.
BIRTHS PER THOUSAND
200
175
150
125
100
75
50
25
0
15–19
20–24
25–29
30–34
35–39
40–44
45–49
AGE GROUP OF MOTHER
CENSUS
VIT.REG.

Misclassifications undoubtedly occur but are expected to largely cancel each other out, so that the overall picture may be taken to represent a subdivision into ethnic groups whose totals can be compared with other censuses and used in calculations.

The census of 1960 presents an opportunity for adjustment of non-reporting of the variable Children Ever Born. Numbers of non-reporting women are tabulated against age, allowing the El Badry adjustment. Under the assumption that a certain part of the women who did not report parity information are actually women with zero parity, the El Badry method essentially uses regression of % non-reporting on % with zero parity to allocate an additional number of women with zero parity, thereby improving the overall quality of the data.

Earlier it could be noticed that some of the tabulations in the annual statistical reports of the Office of Vital Statistics use unorthodox age groupings, from the perspective of demographic analysis. These have been replaced by newly created tabulations using 5-year age groups and referring to years beginning and ending April 1st., based on the actual records. Tabulations that involve ethnic groups can be readily assembled into the four categories that are used in this study. It must be noted however, that in the case of births by ethnicity the variable of ethnicity refers to the mother. Although this may seem controversial the alternative would mean that the Chamorro ethnic group would now be on the verge of extinction, and certainly not number over 50,000 as the census of 1980 reports.

For the purpose of comparability it was also necessary to rearrange the tabulations on Place of Birth and Place of Residence 5 years prior to the census. Individual censuses have provided such information according to the perceived needs of the moment. Analysis through time requires a set of comparable categories, however. Arriving at such a set was possible only by lumping categories together into four groups: U.S. (except Guam), Philippines, Other Asia and "Other". The last category includes mostly Pacific islands and Europe.

Conclusion.

The most pervasive problem in analyzing Guam's demographic data results from the low numbers of population. This poses problems of statistical meaningfulness, especially when small subgroups are considered. Also, reporting errors become relatively more serious under such circumstances. Furthermore, departure from stability, notable from 1950 onwards, tends to aggravate difficulties in appraising the quality of the data.

The two most basic variables for any demographic analysis, age and sex, have been adequately reported in both census and vital registration. Reporting of ethnicity appears to be subject to some inconsistencies, the extent of which cannot be exactly determined, but which seem to be limited to younger age groups. As far as can be judged the variable Children Ever Born has experienced some overall underreporting in the censuses of 1960 and 1970, and will remain of doubtful use as far as the youngest group of mothers is concerned. This is a well-known phenomenon however, that is accounted for in the methods of analysis that focus on this variable. The underreporting of CEB who have died is more serious. At present the variable Children Surviving cannot be used for any indirect methods of estimation, since it implies an unrealistically low level of infant and child mortality.

Reporting of births and deaths in the vital registration system can be viewed with some confidence, although evaluation for these events is hampered by distortion, especially from the factor migration. The long history of this registration system, the high level of accuracy and completeness that can be observed for the period of administration by the U.S. Department of the Navy and the legal consequences of non-reporting assure that omissions occur only non-intentionally, such as deaths (or births) of island residents occurring off-island.

CHAPTER II - POPULATION SIZE AND COMPOSITION.

Population History

Although this analysis focuses exclusively on the period of U.S. administration on Guam, the population that is being administered for the most part has been on the island long before that period. In order to appreciate the relative impact of the dramatic changes that have taken place since the last turn of the century it may be useful to present a synopsis of demographic developments that have occurred on Guam over the last four centuries.

Throughout Guam's written history population data have been collected. During the early years of Spanish rule missionaries made several population estimates. Later, reports on population numbers were made and censuses were taken by government officials.

Underwood (1973) has assembled these sources and by doing so was able to identify five distinct periods in the population history of the Mariana Islands, with many specific references to Guam. The present paragraph adapts this basic idea, which is modified to suit the specific interests of this study and according to additional information that has become available since 1973.

1 - Period of stability (1521 - 1668).

This period is being bordered by two well known events in Guam's history: the discovery of Guam by Magellan in 1521 and the establishment of a permanent Jesuit mission, headed by Padre Sanvitores in 1668. The term "stability" may well be appropriate for this and earlier periods from a demographic point of view. Regarding the circumstances under which the ancient Chamorros lived constant high fertility and widely fluctuating mortality must have prevailed prior to 1668. Initial contacts between natives and foreigners remained superficial, not

disturbing this demographic regime. Various estimates with regard to numbers of total population for this period have been made. Most of these estimates center around 50,000 (Garcia 1683,Von Kotzebue 1821, Roth 1891). However, recently it is believed the Jesuit priests who provided the basic information for these estimates exaggerated the numbers in order to indicate the potential baptisms that could be made on Guam and to obtain more funding from the Spanish government and the Catholic Church. Estimates now mention 20 - 30,000 as the total population of Guam during this period (Hezel 1982), substantiated by an estimate of 30,000 provided by Fritz (1904) based on a house-count.

2 - Period of decline (1669 - 1786).

"...this period, opening with a decade of turmoil and strife, and leading to the forcible resettlement of the native population into concentrated settlements on Guam (with a few hundred refugees remaining on Rota), witnessed the steady, continuing decline of a `native' population, the rapid growth of a mestizo population, and a
steady increase in the number of emigrants from Spain, America and the Philippine Islands. Living conditions, for the native population at least, were probably extremely impoverished, and, in combination with the effects of several epidemics, retarded population recovery for nearly a century." (Underwood 1973 : 19-20).

Censuses, conducted by the Spanish from 1710 until after the end of this period do not provide any insight into the age/sex composition of Guam's population, but do indicate general aspects of the ethnic composition. Underwood (1976) draws the interesting conclusion that racial and/or genealogical features were recognized as important variables used in census assignments. These allow the Chamorro component to be distinguished until well into the 19th. century, contradicting the widespread belief that by this time no full-blooded Chamorros survived.

1960, however. This coincides with the way these data have been gathered and processed in the 1970 census. The 1980 data do not provide such strong evidence of underreporting, and will be discussed in more detail in chapter III, along with the other series, as regards their significance for indicating fertility trends.

In the 1980 census a question was asked on the number of children born during a period of one year prior to the census. This allows cross-checks with reported births from the vital registration system in a similar way to the procedure described above, using the level and pattern of P(i)/F(i) ratios as indicator of distortions. The pattern shown in figure I.6 provides evidence for the conclusion that women aged 15-24 at the time of the 1980 census have severely underreported the number of children born to them during the previous year. This conclusion is further illustrated by figure I.7, which shows Age Specific Fertility Rates for 1980 derived from both census and vital statistics data. The lower levels for the data from vital statistics for the age bracket 35-49 may be related to the practice of adoption; older women taking care of children born by teenagers. In order to obtain a correct birth certificate such births would be registered correctly at the Office of Vital Statistics. However, there would be no such need to report these, often illegitimate, births correctly at a census enumeration.

Adjustment of Incomplete Data.

Many censuses suffer from defects that can be corrected by adjusting the basic data. Such imposition can only be justified when observed irregularities cannot be attributed to influences of changing fertility, mortality, a high level of migration or any kind of disaster. In the case of Guam this essentially means that the basic data have to remain untouched, since the above forces cannot be ruled out. The 1920 census provides an opportunity for adjustment of the

enumerated total. U.S. naval station personnel has not been included in the tabulation, but their number is mentioned in a footnote. Adding these 319 individuals enhances comparability with subsequent census totals.

In a very limited way it is possible to manipulate particular segments of data, so as to allow their use in methods that otherwise could not have been employed at all. This consideration particularly applies to some of the identified limitations of tabulations, especially as far as age groups are concerned. In the case of stable population analysis for the decade 1930-1940, for example, tabulated 10-year age groups were subdivided into 5-year age groups according to the 1940 pattern. Similarly, Children Ever Born in the 1970 census have been tabulated by three 10-year age groups. These were converted into 5-year age groups by utilizing the pattern of this variable for 1960 as well as 1980. Although the published tabulation of this variable for 1980 also contains some 10-year age groups, availability of the summary tape files of this census has allowed the use of actual values in this report. In a few instances, such as the age/sex tabulation of 1920 no information on the number of persons under one year of age was available. In these cases this number was estimated from the number of births minus the number of infant deaths as reported by the vital registration system for the year preceding the census. Whenever needed, a sex-ratio at birth of 1.06 was used to estimate male and female births. Other limiting tabulations, such as the unfortunate age groupings in the case of tabulations of ethnicity for 1980 have been left untouched. The ethnic groups presented in the 1980 census were aggregated into four basic categories in the following way:

Chamorro = "Chamorro", "Guamanian" and "Chamorro and other groups".

Caucasian = "English", "German", "Irish", "European and other groups" and "Not specified or not reported" which includes "American".

Filipino = "Filipino".

"Other" = All other reported groups.

The census of 1710, conducted after the "reduccion", reports 3,197 natives and 417 mestizos on Guam. The numbers of Chamorros steadily declined however, and reached a low of 1,318 in 1786, among a total population of 3,169.

3 - Period of recovery (1787 - 1897).

This period can be subdivided into two segments, both characterized by steady population growth, but separated by a disastrous smallpox epidemic in 1856, which nearly halved Guam's total population. Underwood has located a series of Spanish census reports covering the period 1793-1830 presenting data by ethnicity and sex. From these it can be observed that the number of "Yndios", natives, increased from 1,766 to 2,652 over this period, although their relative contribution to the aggregate population declined from 49.3 to 40.9 percent. Over these 37 years Guam's aggregate population increased from 3,584 to 6,490. Until 1856 most of the population growth must be ascribed to natural increase, since inmigration appears not to have been substantial prior to that year. The census of 1849 reports a total population of 7,940 and the next one in 1871 shows that 6,276 persons were enumerated, including over a thousand Carolinians. After 1872 about one thousand Filipino's were deported to Guam, which was to become used as a penal colony. These, and other developments of lesser magnitude brought Guam's aggregate population to a total of 8,698 according to the Spanish household census of 1897. Censuses since 1830 did not provide usable ethnic categories, and for the most part distinguished population by village. The census of 1897 is the first one to allow tabulations by age and sex.

4 - Period of growth (1898 - 1944).

The change in administration from Spain to the U.S. Naval Authorities marked the beginning of a new era for the population of Guam. During this period major changes in demographic characteristics began to evolve. This paragraph and the

FIGURE II.1

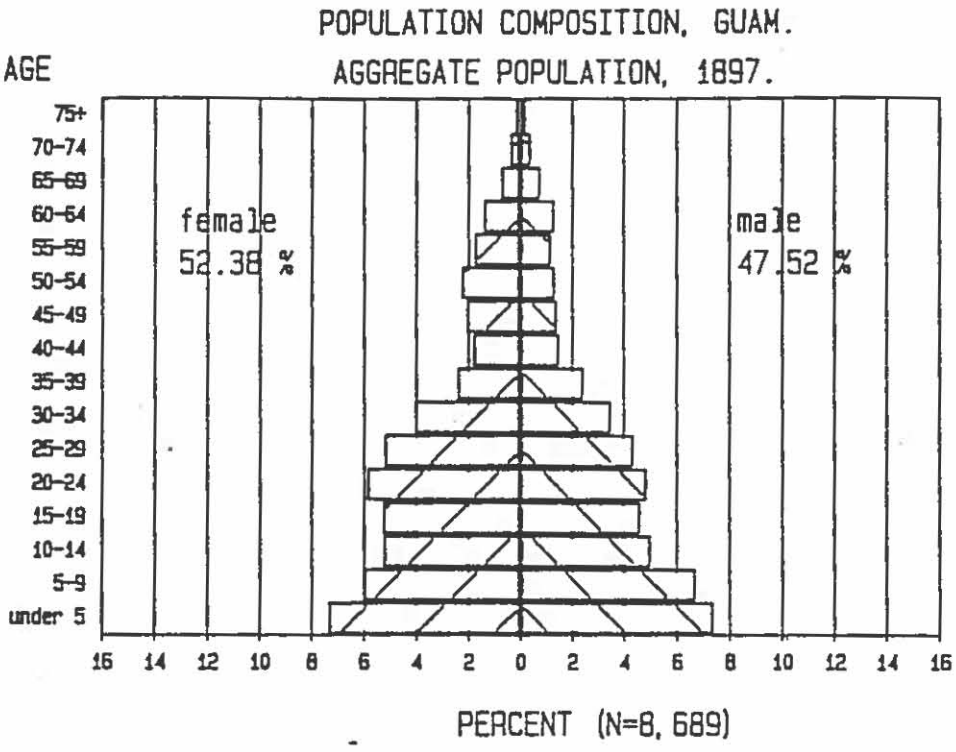
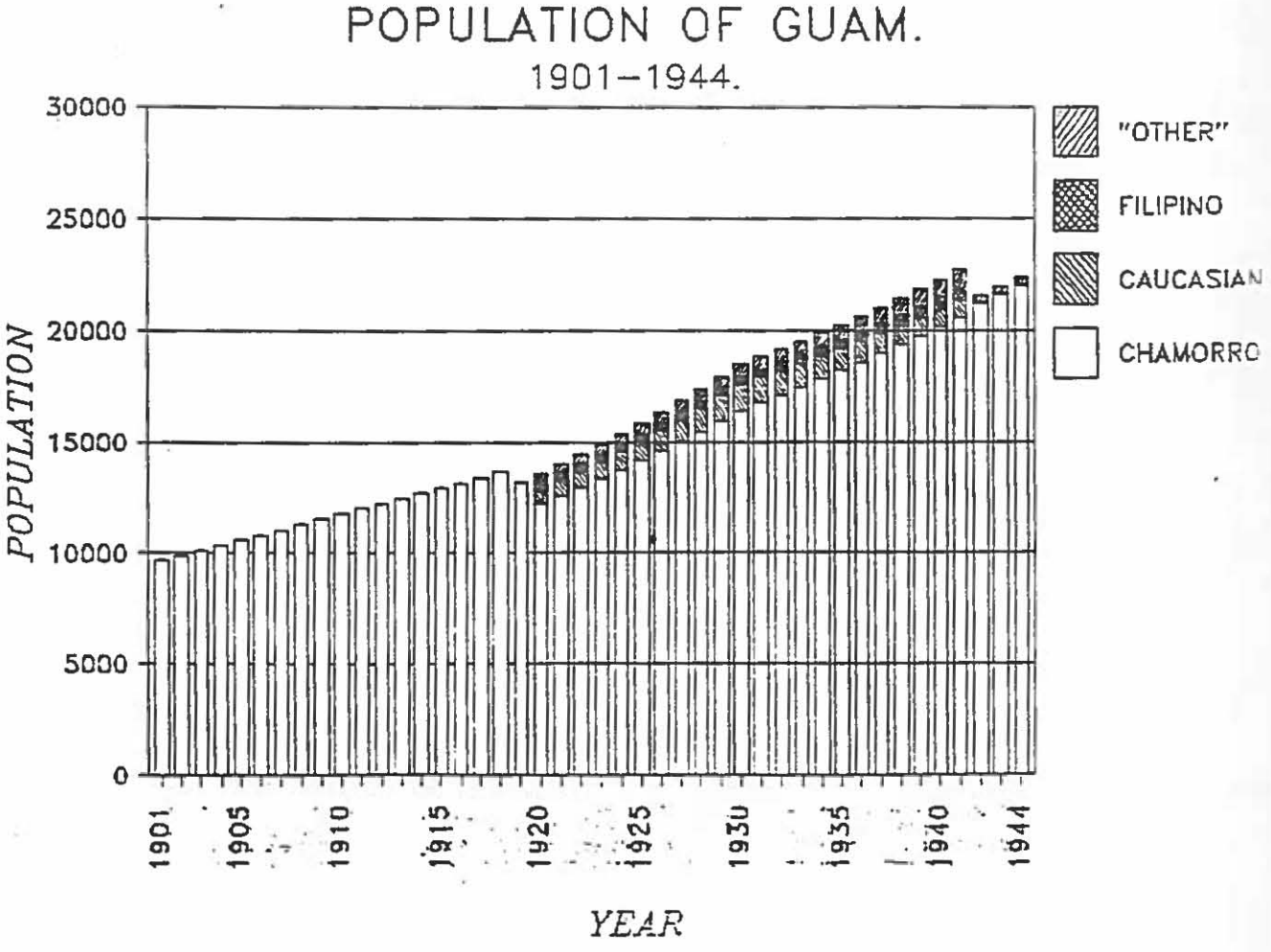


FIGURE II.2



next two present basic descriptions of the population that underwent these changes.

Since the first two censuses under U.S. administration did not record information other than population totals, it seems useful at this point to present the age/sex distribution as it had been recorded in 1897, since this may at least be taken as an indication of such distributions in later years. Moreover, it serves to indicate general trends and illustrates distortions the origin of which can subsequently be identified. Figure II.1 shows an age/sex structure (age pyramid) that is typical of a population experiencing rapid natural increase, as is indicated by its relatively broad base. Another apparent feature is the constriction that occurs in both sexes around the age group 40-45. These people were born in the years 1852 to 1857, which encompasses the above mentioned smallpox epidemic. It can therefore be inferred that the deficit in this and the subsequent age groups is to be attributed to this event. The moderate surplus for both sexes in the age group 20-35 is indicative of recent inmigration. The rapid growth of Guam's population around the turn of the century is substantiated by the fact that the annual growth rate amounted to approximately 2.7% between 1897 and 1901, the population size increasing to 9,676. Subsequent developments in the totals of each census of this period have been plotted in figure II.2. Average annual rates of change for the aggregate population over subsequent censuses in this and the next period of population development are tabulated in table II.1. All in all, from 1901 to 1944 Guam's aggregate population increased by 2.0% annually. World War II caused vast changes and strongly influenced later developments. The Japanese occupation (1941-1944) disrupted family life in many ways, varying from relocation to massacre, thereby reversing earlier population growth. The census of 1940 shows a total population of 22,290 whereas a census, taken by the U.S. military government in November 1944, reports a total `native' population of 21,675 and 6 resident Filipinos. The period under consideration is

further characterized by a limited extent of inmigration, largely consisting of personnel of the naval establishment. The paragraph on population composition will bring out more detail of Guam's migrant population.

5 - Period of compound growth (1945-present).

After World War II Guam's population jumped to 59,498 within a period of five years. Although there did occur a postwar baby-boom this dramatic increase is mainly due to the inmigration of some 23,000 military personnel and 7,000 Filipinos, mainly contract workers. The liberation of Guam had caused a devastation of buildings and infrastructure. Rebuilding began immediately after the war and took place according to plans, designed by the Naval Authorities.

On the one hand, the new layout of Guam's municipalities was undoubtedly favorable to sanitary conditions and, in combination with massive vaccinations, prevented epidemics as severe as those that took place in earlier periods. On the other hand, forced relocation of families, the acquisition of one third of the island's surface area for military installations and the fact that once again the Chamorro population became a minority in its own niche, contributed to a process of alienation from patterns of culture that existed before the war. In subsequent chapters this period, whose main characteristic is an increasingly complex population structure through inmigration, outmigration and varying levels of natural increase, will be subject to a great deal of attention. Suffice it here to point out that the overall population growth for the period 1950-1980 amounts to 1.9% annually, yet shows increasing disparities between the various ethnic groups, especially since 1970.

FIGURE II.3 (a)

POPULATION OF GUAM.

1920

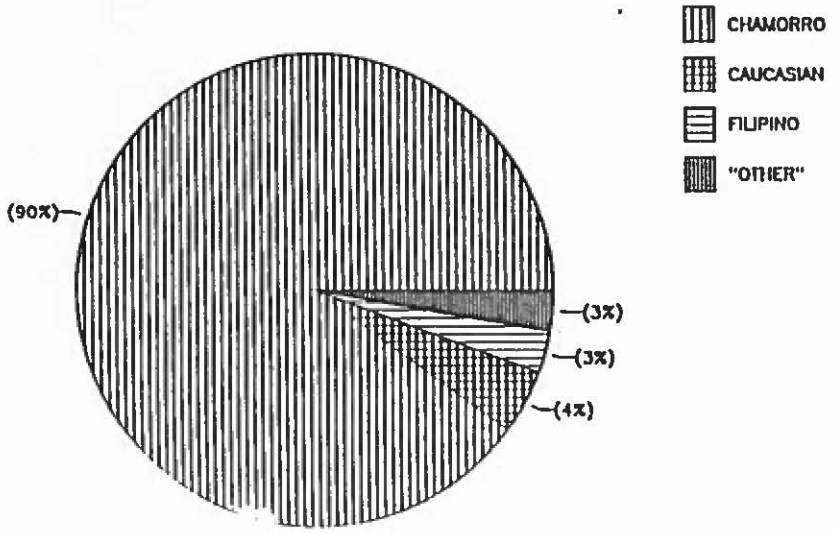


FIGURE II.3 (b)

POPULATION OF GUAM.

1930

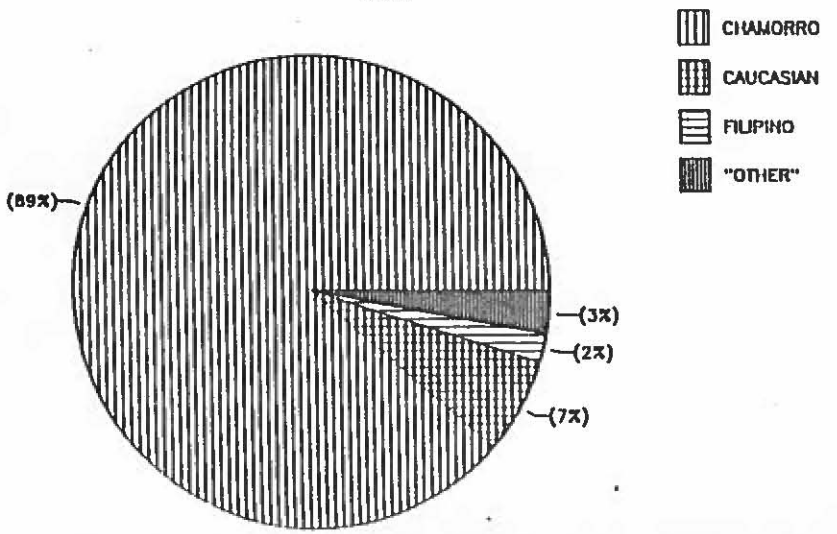


FIGURE II.3 (c)

POPULATION OF GUAM.

1940

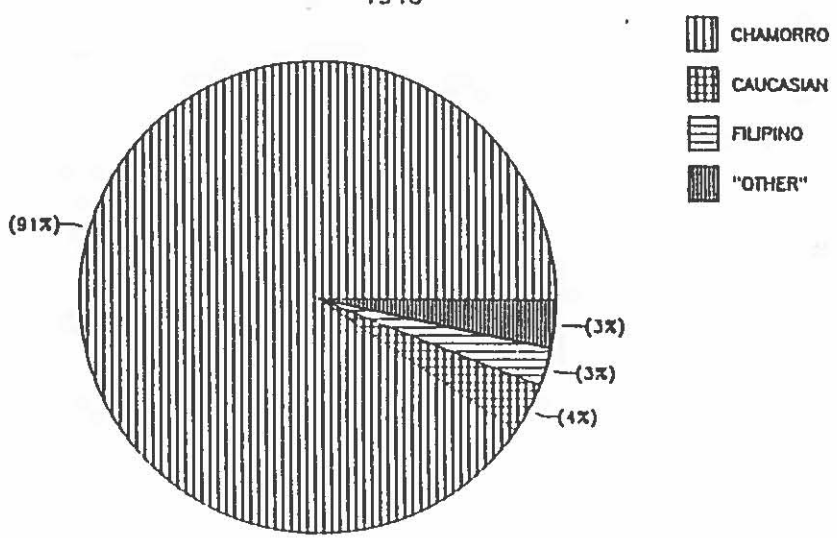


FIGURE II.3 (d)

POPULATION OF GUAM.

1950

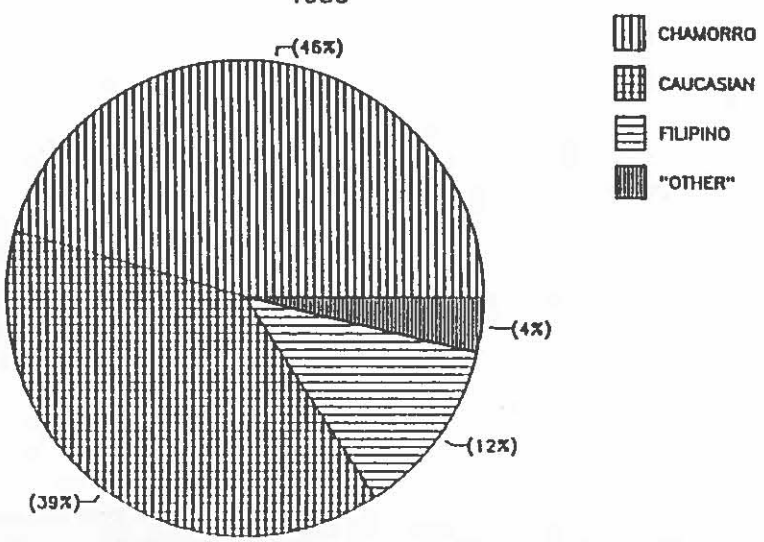


FIGURE II.3 (e)

POPULATION OF GUAM.

1960

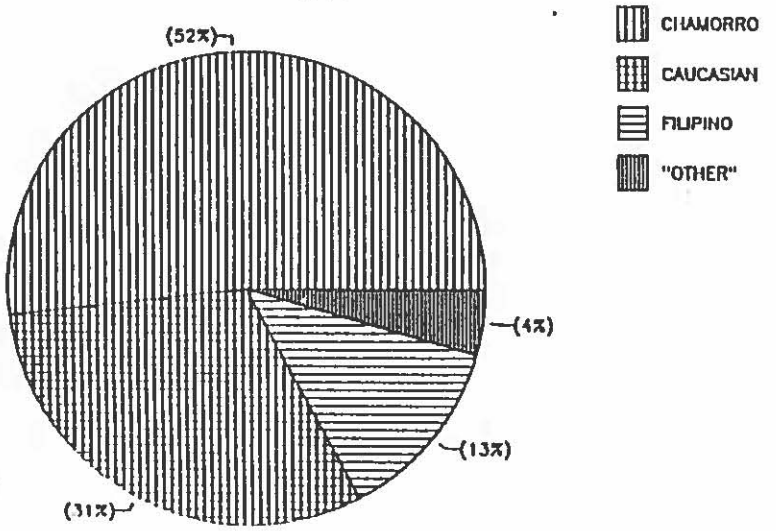


FIGURE II.3 (f)

POPULATION OF GUAM.

1970

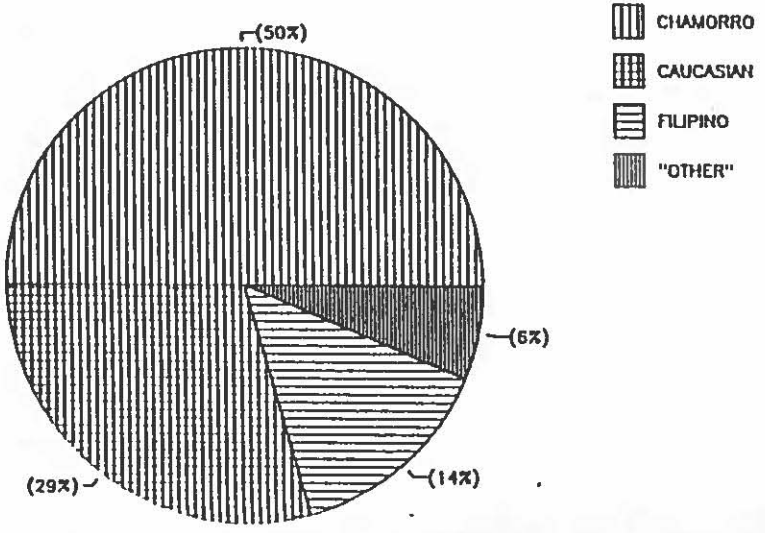
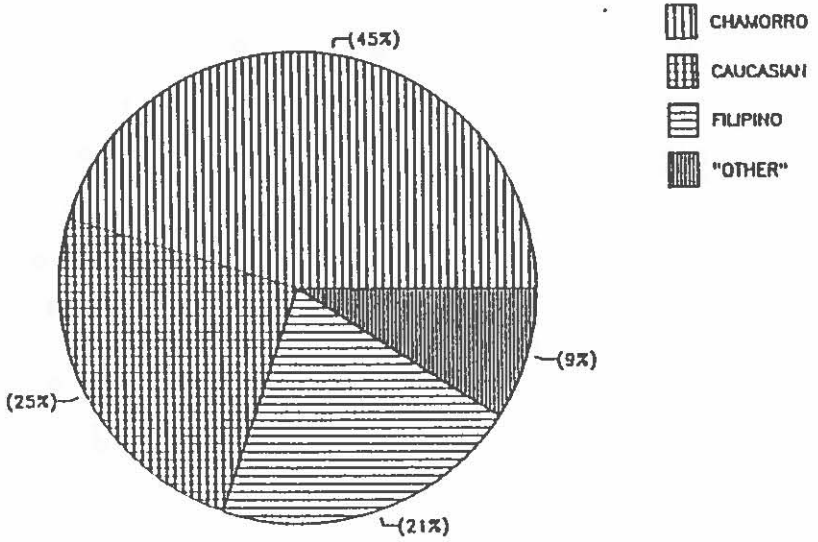


FIGURE II.3 (g)

POPULATION OF GUAM.

1980



Population Composition.

Figure II.3 depicts the percentage distribution of the four major ethnic categories as recorded since 1920. The earlier mentioned influx of non-Chamorros since 1945 is well evidenced by this figure. The developments since 1945 are further illustrated by figure II.4, which shows the ethnic groups by numbers as they add up to the totals of the aggregate population.

The cumulation in figure II.4 tends to visually even out minor changes in size within a particular category. Table II.1 presents an overview of the average annual rates of change for each ethnic group, calculated according to the exponential approximation. From 1950 to 1970 the average annual growth rate for Chamorros was 2.2%, as opposed to 1.2% during the next 10 years. The largest part of the period under consideration indicates an impressive growth in the Filipino and "Other" population groups. These developments will be further elucidated in the chapter on migration.

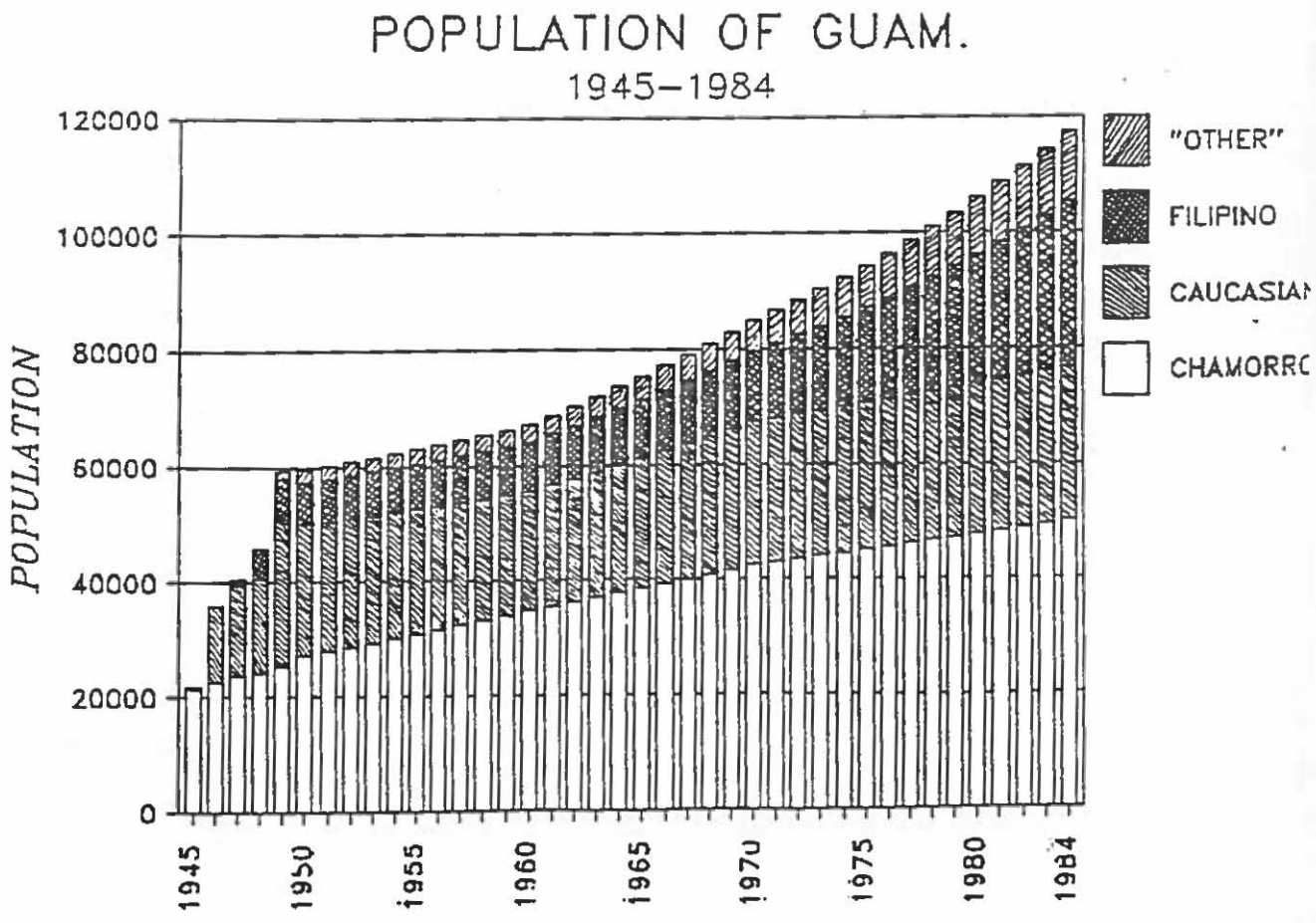
A convenient way of gaining insight into the composition of a population is by making use of age-pyramids, as was done in the case of the 1897 census results. Such pyramids have been drawn up for all data that allow this to be done, i.e. for censuses since 1940. Figures II.5 a,b and c show this information, pertaining to the Chamorro population. The age pyramid for 1940 appears fairly regular, especially so on the female side. The deficit that shows in the age groups 15-19 and 20-24 may be attributed to epidemics of whooping cough and influenza that occurred in 1924 and 1918, respectively (see also chapter IV). The much larger deficit for males however, can only be explained by taking the factor migration into account. The age-structure that shows for 1950 clearly depicts influences of World War II. The youngest age group in figure II.5 b, born since 1945, clearly indicates a baby-boom. The next age group includes the effects of postponement of childbirth during the occupation years and a high level of infant and child

TABLE II.1
AVERAGE ANNUAL RATES OF CHANGE.
POPULATION OF GUAM, 1901-1980.
EXPONENTIAL APPROXIMATION

POPN GROUP	PERIOD 1901-10	1910-20	1920-30	1930-40	1940-50	1950-60	1960-70	1970-80
AGGREGATE								
P(0)	9,676	11,806	13,595	18,509	22,290	59,498	67,044	84,996
P(1)	11,806	13,595	18,509	22,290	59,498	67,044	84,996	105,979
r(%)	2.211	1.411	3.086	1.859	9.818	1.194	2.373	2.206
CHAMORRO								
P(0)	*	*	12,216	16,402	20,177	27,124	34,762	42,532
P(1)	*	12,216	16,402	20,177	27,124	34,762	42,532	47,845
r(%)	*	*	2.947	2.071	2.959	2.481	2.017	1.177
CAUCASIAN								
P(0)	*	*	599	1,205	785	22,920	20,724	24,882
P(1)	*	599	1,205	785	22,920	20,724	24,882	25,987
r(%)	*	*	6.990	-4.286	33.741	-1.007	1.829	.435
FILIPINO								
P(0)	*	*	396	365	569	7,258	8,580	12,190
P(1)	*	396	365	569	7,258	8,580	12,190	22,447
r(%)	*	*	-.815	4.440	25.460	1.673	3.512	6.105
"OTHER"								
P(0)	*	*	384	537	759	2,196	2,978	5,392
P(1)	*	384	537	759	2,196	2,978	5,392	9,700
r(%)	*	*	3.354	3.460	10.624	3.046	5.937	5.872

Note:
* not available

FIGURE II.4



mortality as prevailed around the time of liberation. A third notable feature of this figure is the deficit for males aged 25-34 years in 1950. Although part of this may have been caused by the onset of Chamorro outmigration, vital statistics for the years 1944-45 strongly suggest that events occurring around the time of liberation largely account for the noted deficit. The pattern for 1960 reflects the same type of events. Its broad base suggests that the high level of fertility after World War II continued for about 10 years. Another deficit in the male population, over and above those noted ten years earlier, shows for the age groups 20-24 and 25-29. Its location in time indicates the effects of outmigration.

The differences between the male and female age structures are brought out even more clearly in table II.2, where sex-ratios by age group are calculated. Data for 1930 are now included since the unequal size of age-groups in this format does not significantly affect comparability. The usual pattern for sex-ratios is to decline in a regular manner as age increases, from an initial level of about 1.05. Chance variation, due to low numbers, may account for minor distortions in this pattern, i.e. for the youngest age groups in 1940 and 1950.

Age pyramids for the Caucasian population (figure II.6 a,b,c) clearly indicate the lopsided character of migrant population groups: an enormous excess of males over females from the age group 15-19 onwards. The female component tends to be concentrated within the age brackets of 25 to 39 years.

The Filipino and "Other" population groups both show a fairly well balanced age distribution for 1940 with aberrations that can be ascribed to the low absolute numbers and past epidemics (figures II.7 and 8). For 1950 and 1960 the influence of migration becomes evident.

To complete the picture so far presented, age-pyramids and sex-ratios pertaining to the aggregate population for the period 1920 to 1980 are shown in figures II.9 and table II.3. These depict the net effect of the various influences that were

FIGURE II.5 (a)

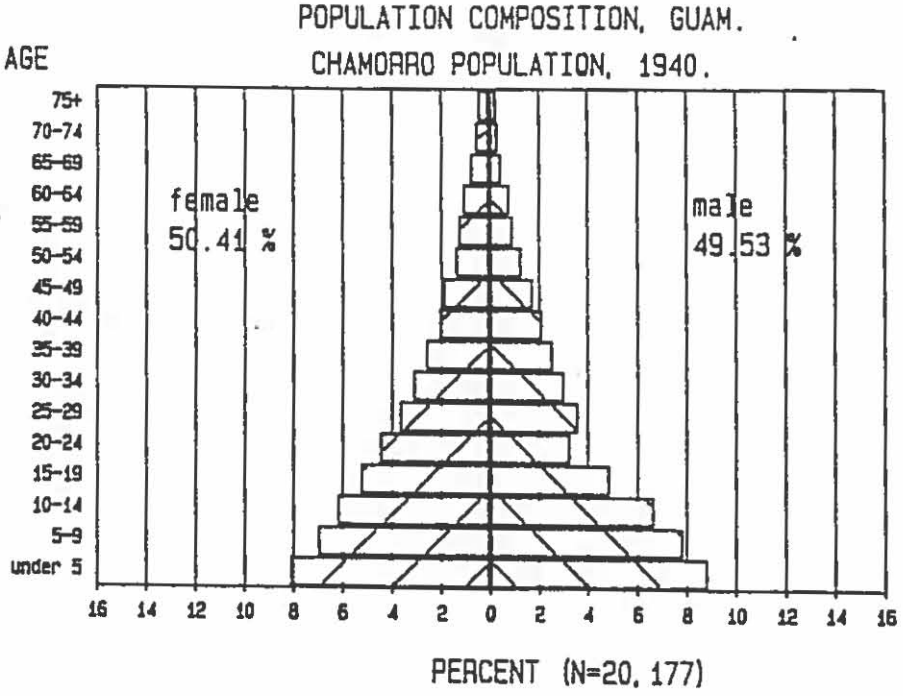


FIGURE II.5 (b)

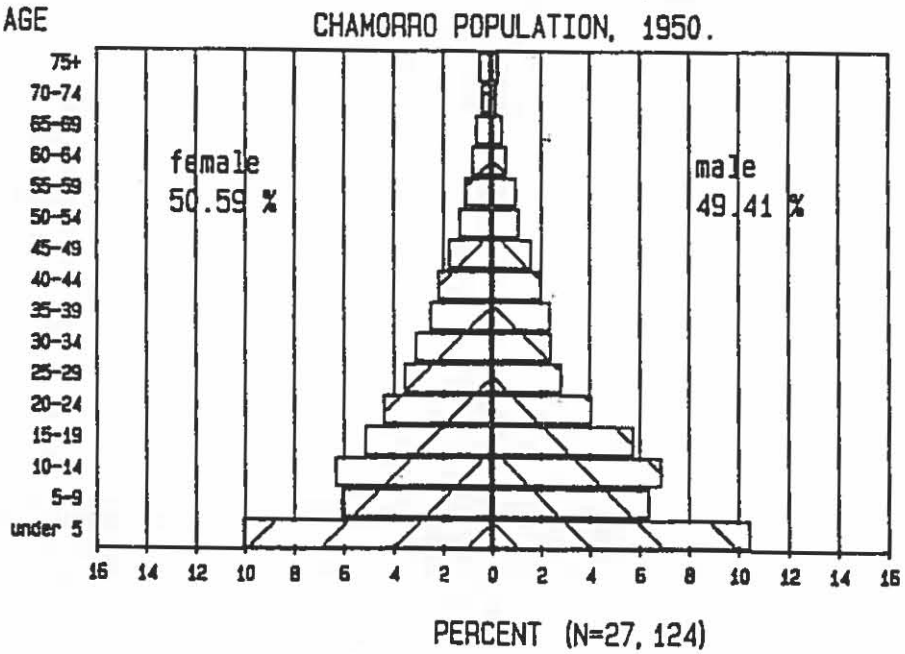


FIGURE II.5 (c)

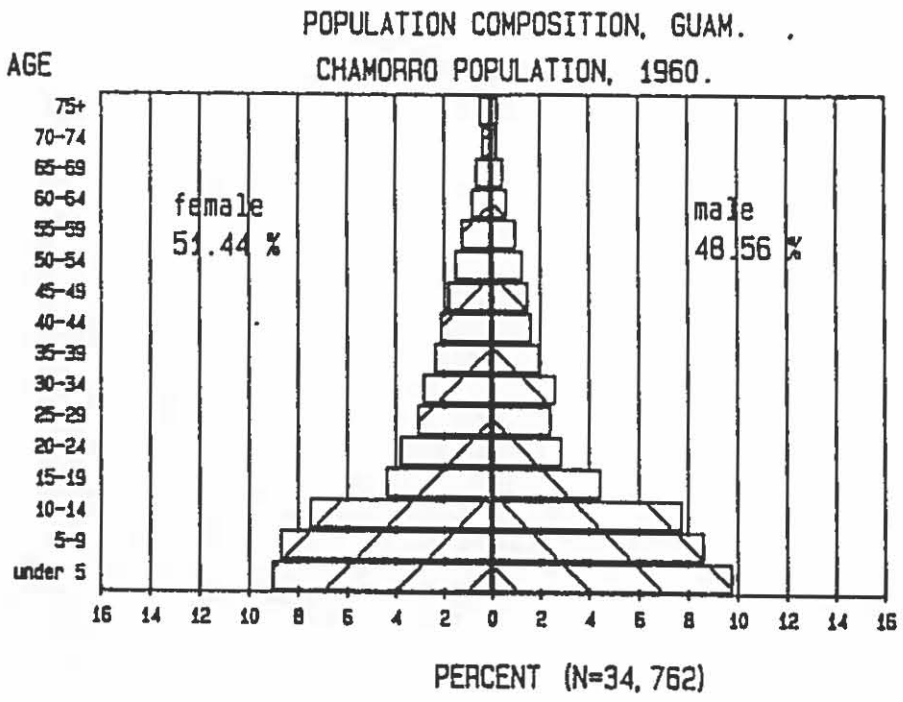


FIGURE II.6 (a)

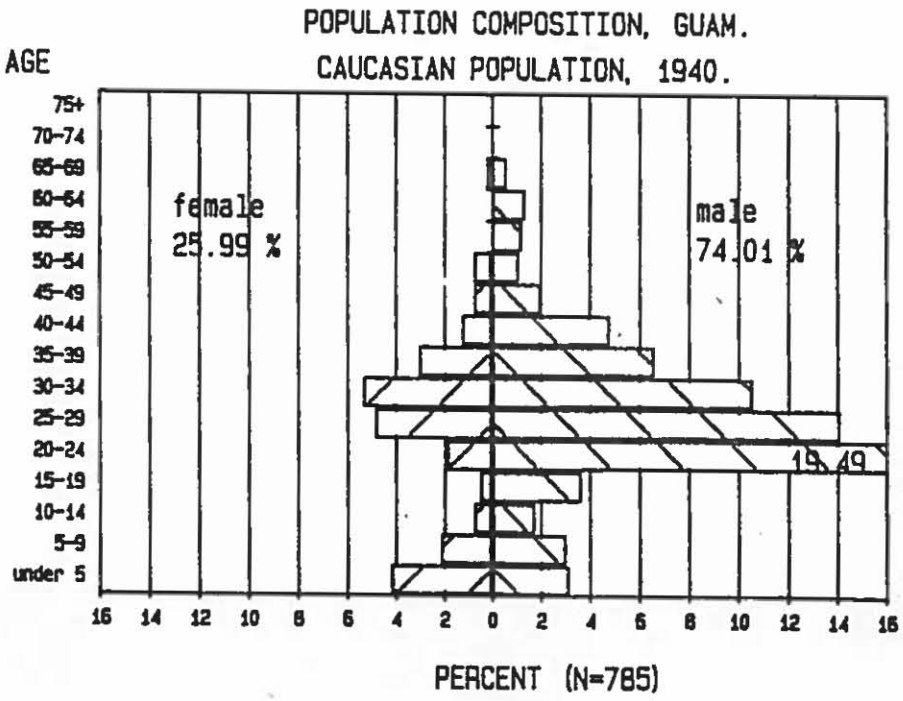


FIGURE II.6 (b)

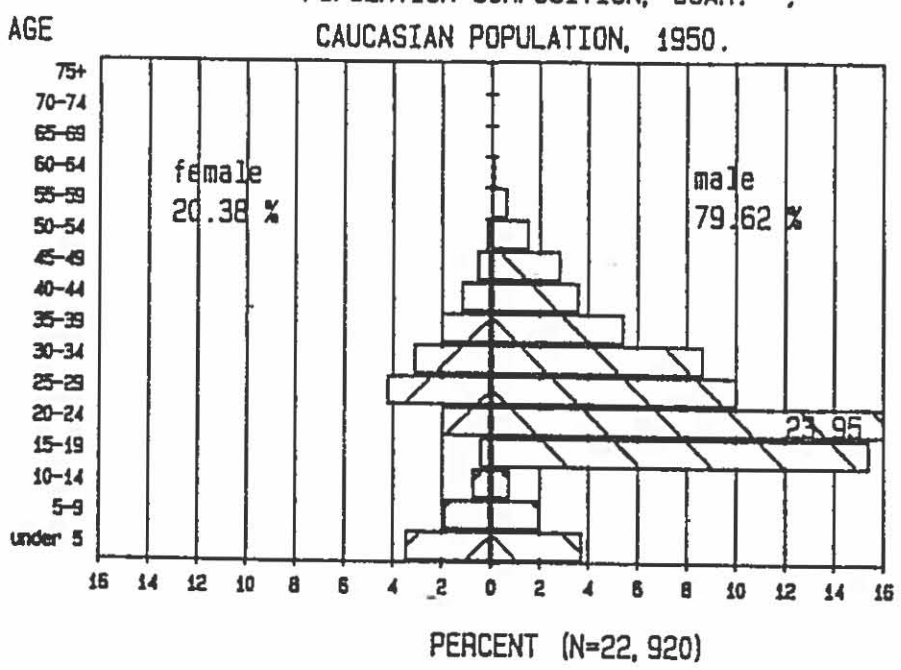


FIGURE II.6 (c)

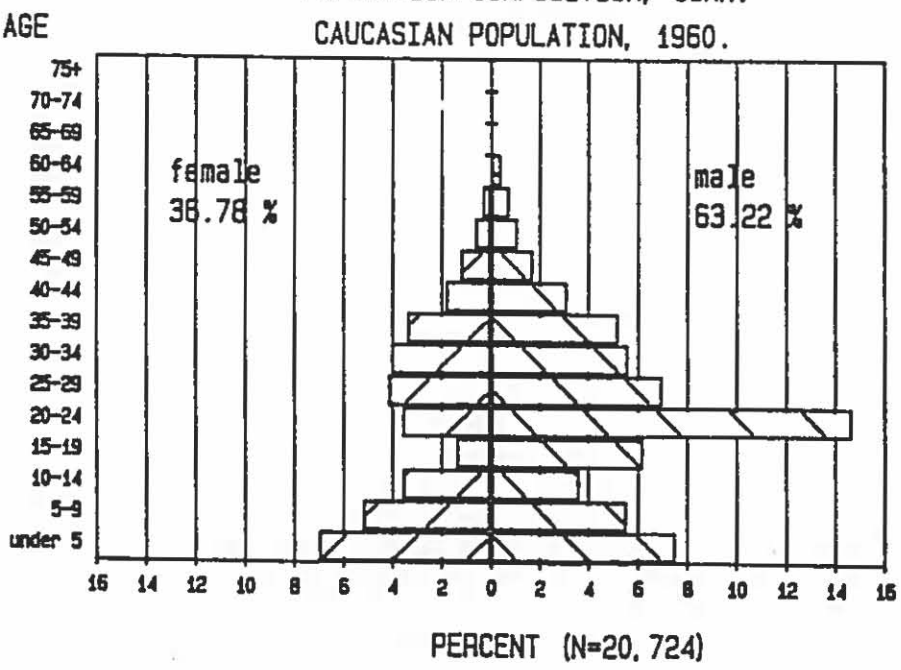


FIGURE II.7 (a)

POPULATION COMPOSITION, GUAM.

FILIPINO POPULATION, 1940.

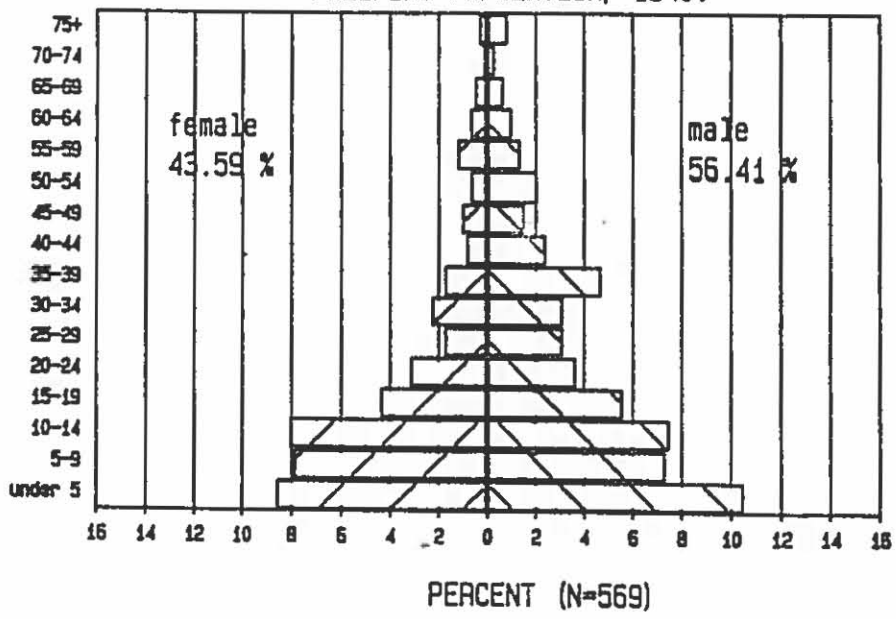


FIGURE II.7 (b)

POPULATION COMPOSITION, GUAM.

FILIPINO POPULATION, 1950.

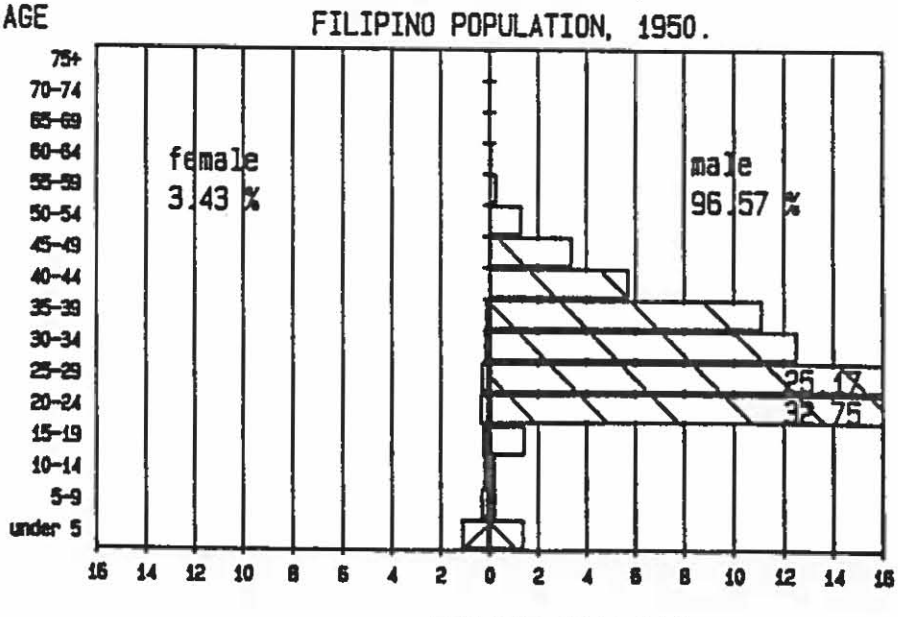


FIGURE II.7 (c)

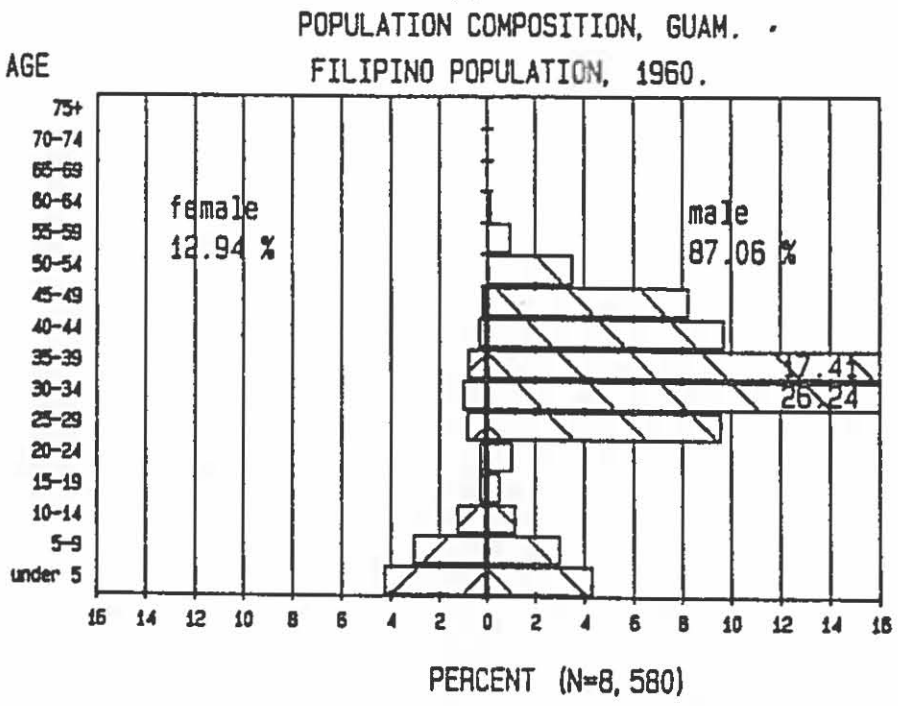


FIGURE II.8 (a)

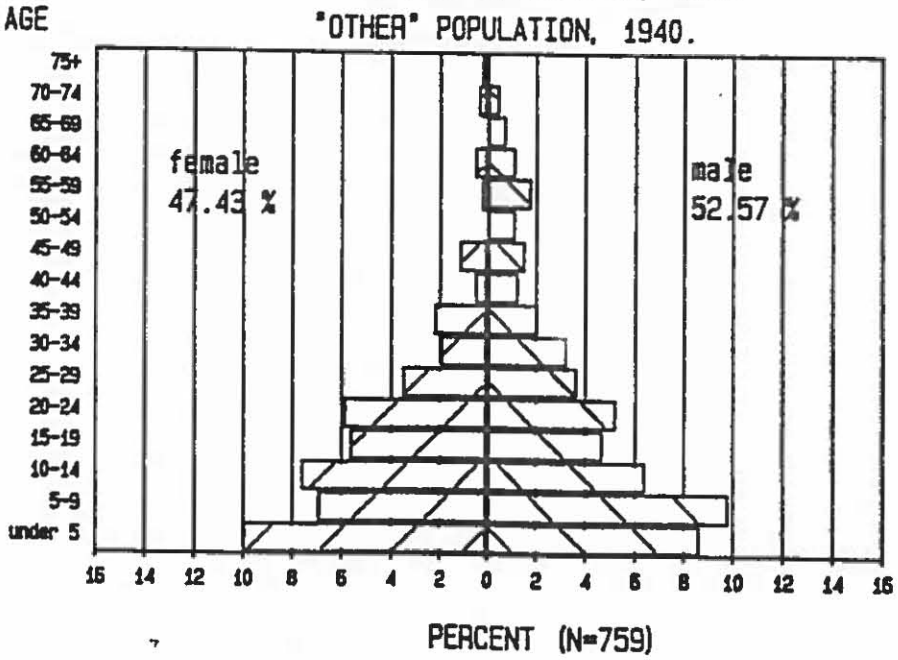


FIGURE II.8 (b)

POPULATION COMPOSITION, GUAM.
"OTHER" POPULATION, 1950.

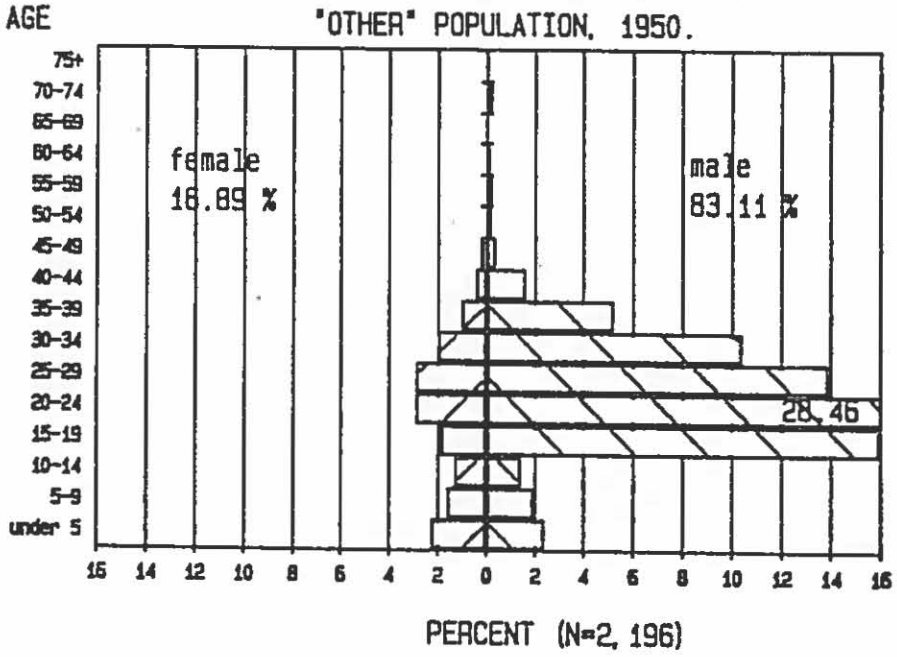


FIGURE II.8 (c)

POPULATION COMPOSITION, GUAM.
"OTHER" POPULATION, 1960.

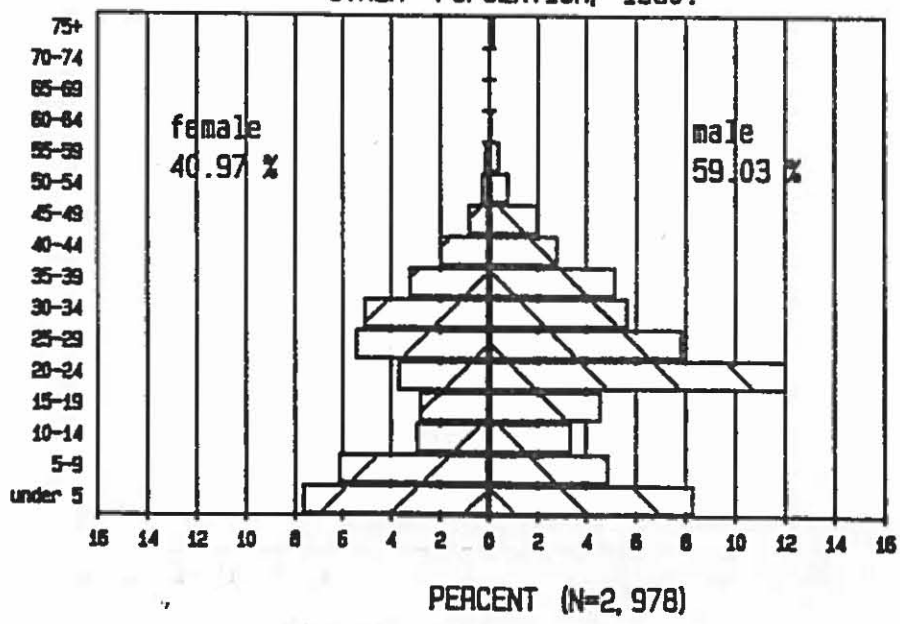


FIGURE II.9 (a)

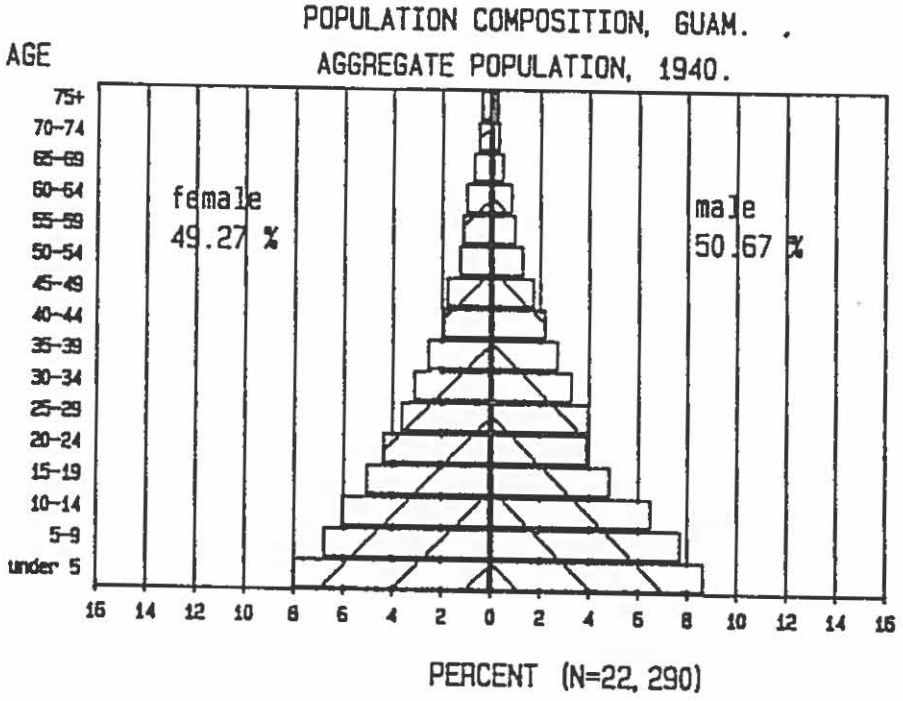


FIGURE II.9 (b)

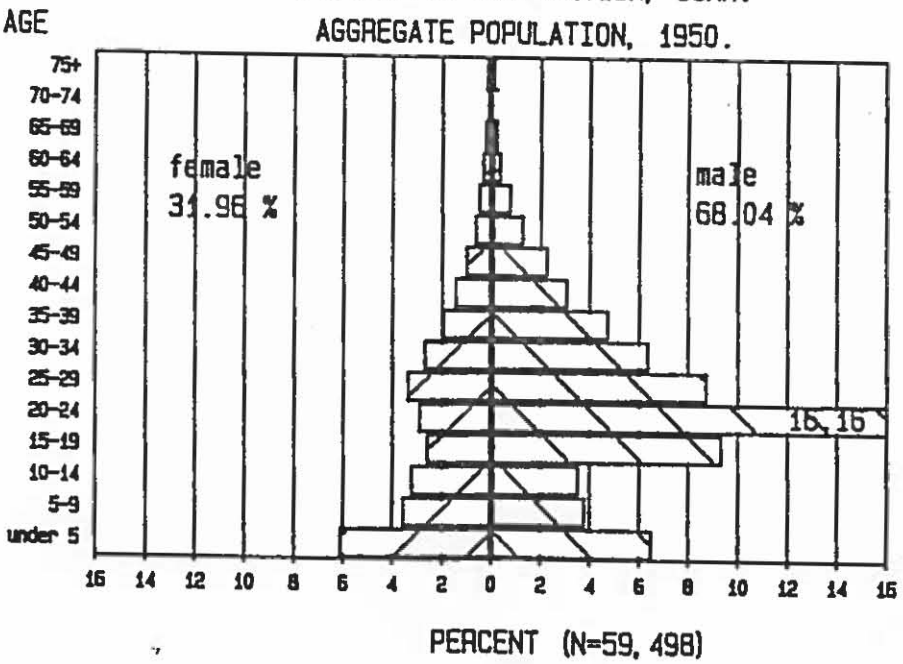


FIGURE II.9 (c)

POPULATION COMPOSITION, GUAM.

AGGREGATE POPULATION, 1960.

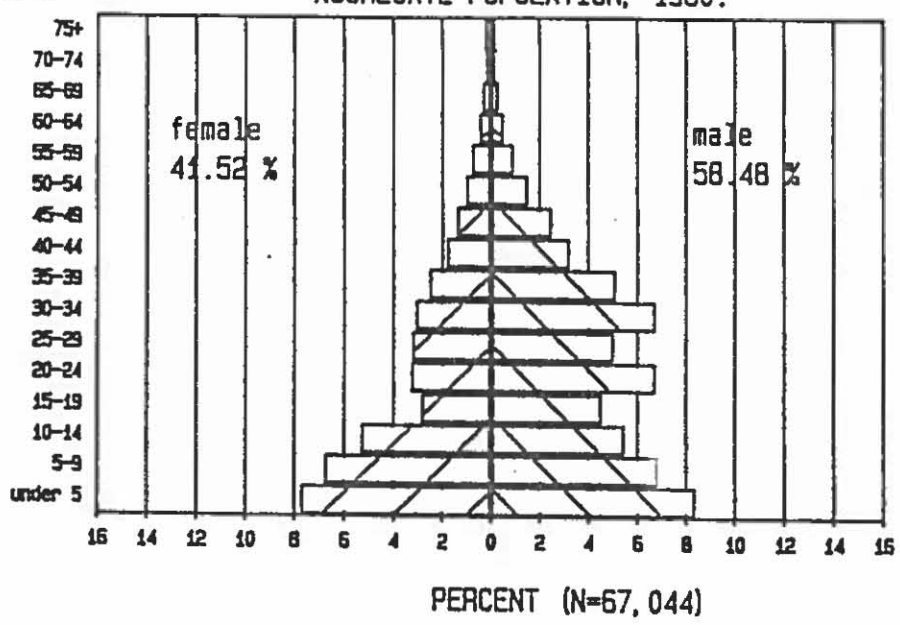


FIGURE II.9 (d)

POPULATION COMPOSITION, GUAM.

AGGREGATE POPULATION, 1970.

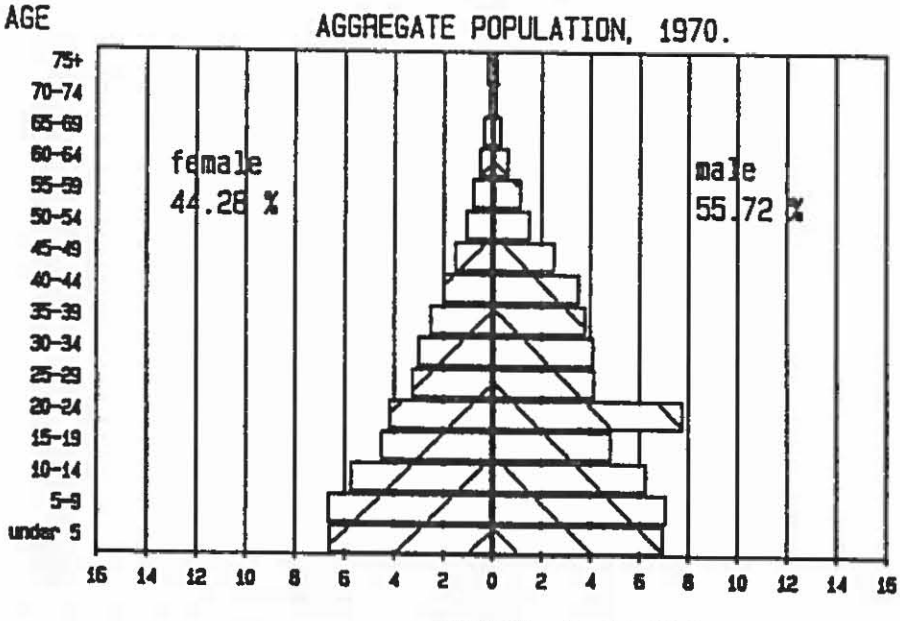


FIGURE II.9 (e)

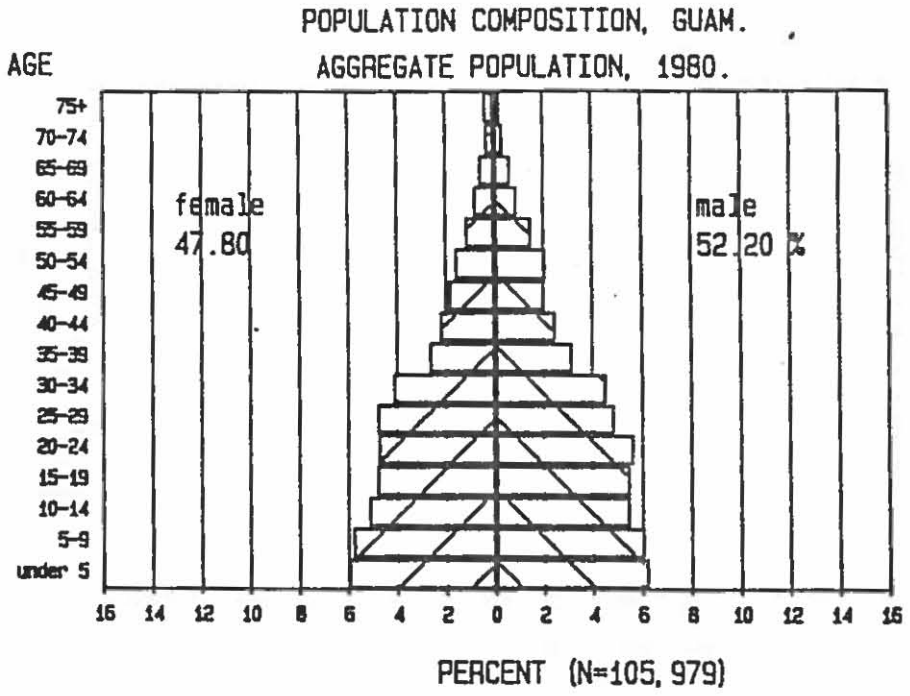

POPULATION COMPOSITION, GUAM.
AGGREGATE POPULATION, 1980.
AGE
75+
70-74
65-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19
10-14
5-9
under 5
female
47.80
male
52.20 %
16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16
PERCENT (N=105, 979)

TABLE II.2
SEXRATIOS BY AGE, CHAMORRO POPULATION.

YEAR	1930			1940		
AGE	MALE	FEMALE	SEXRATIO	MALE	FEMALE	SEXRATIO
0- 4	1,524	1,423	1.071	1,794	1,643	1.092
5- 9	1,135	1,117	1.016	1,593	1,412	1.128
10-14	1,004	980	1.024	1,357	1,254	1.082
15-19	855	811	1.054	995	1,064	.935
20-24	700	705	.993	671	907	.740
25-29	601	637	.943	740	747	.991
30-34	506	498	1.016	622	637	.976
35-39				526	531	.991
40-44	800	787	1.017	442	423	1.045
45-49				365	389	.938
50-54	489	585	.836	270	288	.938
55-59				199	261	.762
60-64	340	464	.733	173	228	.759
65-69				104	166	.627
70-74	146	200	.730	76	122	.623
75+	28	67	.418	66	99	.667
TOTAL	7,614	7,543	1.009	9,993	10,171	.982

YEAR	1950			1960		
AGE	MALE	FEMALE	SEXRATIO	MALE	FEMALE	SEXRATIO
0- 4	2,852	2,744	1.039	3,422	3,158	1.084
5- 9	1,751	1,663	1.053	3,024	3,039	.995
10-14	1,887	1,730	1.091	2,716	2,627	1.034
15-19	1,577	1,407	1.121	1,569	1,534	1.023
20-24	1,122	1,206	.930	1,020	1,334	.765
25-29	786	979	.803	867	1,084	.800
30-34	671	857	.783	936	1,008	.929
35-39	663	692	.958	703	840	.837
40-44	561	607	.924	591	757	.781
45-49	454	489	.928	543	647	.839
50-54	319	372	.858	467	543	.860
55-59	287	304	.944	372	444	.838
60-64	180	225	.800	245	296	.828
65-69	135	183	.738	189	240	.788
70-74	68	117	.581	103	146	.705
75+	90	146	.616	114	184	.620
TOTAL	13,403	13,721	.977	16,881	17,881	.944

TABLE II.3
SEXRATIOS BY AGE, AGGREGATE POPULATION.

YEAR	1930			1940		
AGE	MALE	FEMALE	SEXRATIO	MALE	FEMALE	SEXRATIO
0- 4	1,633	1,538	1.062	1,945	1,801	1.080
5- 9	1,234	1,213	1.017	1,734	1,527	1.136
10-14	1,090	1,063	1.025	1,463	1,364	1.073
15-19	1,053	878	1.199	1,092	1,136	.961
20-24	1,066	754	1.414	885	985	.898
25-29	813	693	1.173	897	822	1.091
30-34	640	548	1.168	748	707	1.058
35-39				621	582	1.067
40-44	951	843	1.128	504	442	1.140
45-49				402	410	.980
50-54	580	601	.965	300	299	1.003
55-59				231	270	.856
60-64	373	477	.782	199	236	.843
65-69				119	172	.692
70-74	163	203	.803	83	127	.654
75+	34	68	.500	71	103	.689
TOTAL	9,060	8,131	1.114	11,294	10,983	1.028

YEAR	1950			1960		
AGE	MALE	FEMALE	SEXRATIO	MALE	FEMALE	SEXRATIO
0- 4	3,885	3,683	1.055	5,614	5,210	1.078
5- 9	2,286	2,167	1.055	4,593	4,571	1.005
10-14	2,129	1,955	1.089	3,685	3,569	1.033
15-19	5,583	1,579	3.536	3,053	1,941	1.573
20-24	9,613	1,765	5.446	4,527	2,217	2.042
25-29	5,231	2,044	2.559	3,386	2,186	1.549
30-34	3,812	1,640	2.324	4,526	2,091	2.165
35-39	2,850	1,194	2.387	3,440	1,711	2.011
40-44	1,859	902	2.061	2,172	1,231	1.764
45-49	1,380	634	2.177	1,684	947	1.778
50-54	793	423	1.875	1,036	700	1.480
55-59	482	328	1.470	642	529	1.214
60-64	243	240	1.013	367	328	1.119
65-69	157	189	.831	223	255	.875
70-74	84	120	.700	117	154	.760
75+	98	150	.653	146	193	.756
TOTAL	40,485	19,013	2.129	39,211	27,833	1.409

YEAR	1970			1980		
AGE	MALE	FEMALE	SEXRATIO	MALE	FEMALE	SEXRATIO
0- 4	5,962	5,673	1.051	6,620	6,382	1.037
5- 9	6,054	5,708	1.061	6,458	6,174	1.046
10-14	5,362	4,942	1.085	5,835	5,503	1.060
15-19	4,148	3,901	1.063	5,849	5,144	1.137
20-24	6,642	3,628	1.831	6,019	5,089	1.183
25-29	3,569	2,837	1.258	5,194	5,130	1.012
30-34	3,538	2,633	1.344	4,854	4,435	1.094
35-39	3,267	2,207	1.480	3,386	2,860	1.184
40-44	3,038	1,754	1.732	2,650	2,399	1.105
45-49	2,192	1,338	1.638	2,171	2,018	1.076
50-54	1,334	971	1.374	2,238	1,745	1.283
55-59	1,015	733	1.385	1,634	1,280	1.277
60-64	577	493	1.170	1,008	919	1.097
65-69	324	365	.888	729	689	1.058
70-74	160	191	.838	392	417	.940
75+	180	260	.692	284	474	.599
TOTAL	47,362	37,634	1.258	55,321	50,658	1.092

pointed out in the above discussion. Developments regarding the years 1970 and 1980 can be summarized by pointing out that overall increase in population tends to even out most of the distortions, although a disproportionate percentage of both males and females in the age groups 20-35 can still be observed. It can further be noted that figures II.9 d and e have a nearly constrictive configuration, indicating a decrease in the proportion children.

A general outline of the above information can be achieved by employing a summary measure like the Dependency Ratio. For this purpose the population under consideration is divided into three broad age groups: 0-14,15-64 and 65+. This measure uses the age group 15-64 as base population, and reports the other two age groups as percentage of this base. The sum of the two percentages constitutes the Dependency Ratio. It is frequently used because of its general socioeconomic relevance; it indicates how many other persons one individual of working age has to support. Table II.4 gives these values, in the form of percentages, for the years 1920 to 1980. For the aggregate and Chamorro population this information is graphically represented in figures II.10 a and b. Special mention must be made regarding the 1980 values. These show a lowering of the proportion under 15 years of age for the Chamorro and Caucasian population groups, and, more importantly, indicate a sudden jump in the proportion over age 65. The information presented also illustrates that strong inmigration tends to lower the Dependency Ratio, since migrants are typically of working age, at least in the case of Guam.

Conclusion.

Research into Guam's population history has resulted in five periods of population development to become identified: a period of stability, a period of decline, one of recovery, a period of growth and a period of compound growth. The latter two periods cover the present century and are separated by the second

TABLE II.4
DEPENDENCY RATIOS, GUAM 1920-1980.

POPN GROUP	YEAR 1920	1930	1940	1950	1960	1970	1980
AGGREGATE POPULATION							
under 15	78.86%	75.67%	83.47%	37.81%	70.37%	67.65%	58.79%
over 65	3.99%	4.56%	5.73%	1.87%	2.81%	2.97%	9.73%
total	82.85%	80.22%	89.20%	39.68%	73.18%	70.62%	68.52%
CHAMORRO POPULATION							
under 15	*	81.83%	86.29%	91.78%	113.84%	*	81.15%
over 65	*	5.02%	6.03%	5.37%	6.18%	*	13.95%
total	*	86.85%	92.33%	97.15%	120.01%	*	95.09%
CAUCASIAN POPULATION							
under 15	*	12.58%	18.11%	14.83%	48.69%	*	38.84%
over 65	*	.56%	1.37%	.18%	.53%	*	1.50%
total	*	13.15%	19.48%	15.01%	49.21%	*	40.34%
FILIPINO POPULATION							
under 15	*	87.63%	106.74%	4.00%	21.16%	*	46.31%
over 65	*	8.60%	6.37%	.14%	.35%	*	5.79%
total	*	96.24%	113.11%	4.15%	21.51%	*	52.10%
"OTHER" POPULATION							
under 15	*	120.75%	103.01%	12.53%	50.92%	*	59.82%
over 65	*	2.07%	4.37%	.67%	.71%	*	30.79%
total	*	122.82%	107.38%	13.20%	51.63%	*	90.61%

Note:
* Not available

FIGURE II.10 (a)

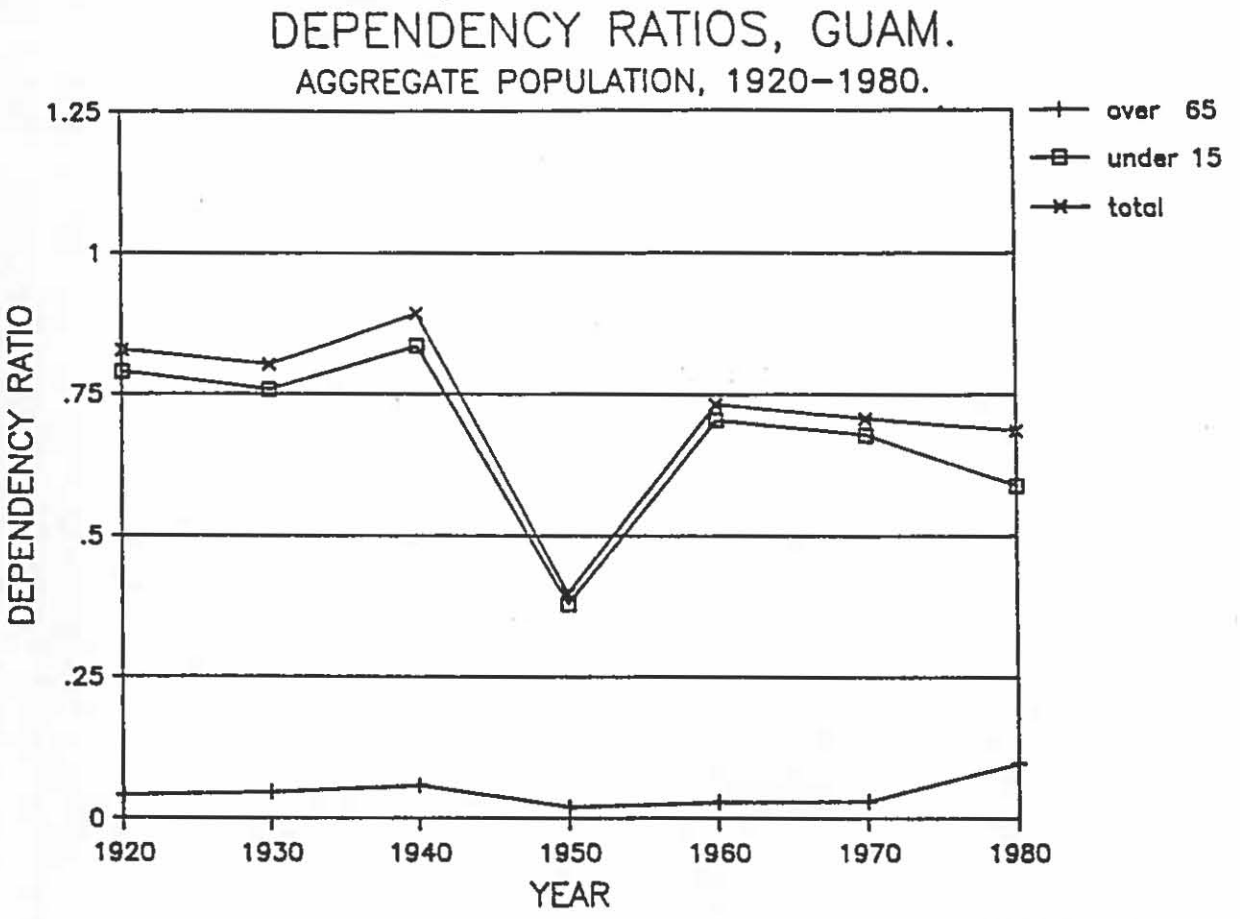
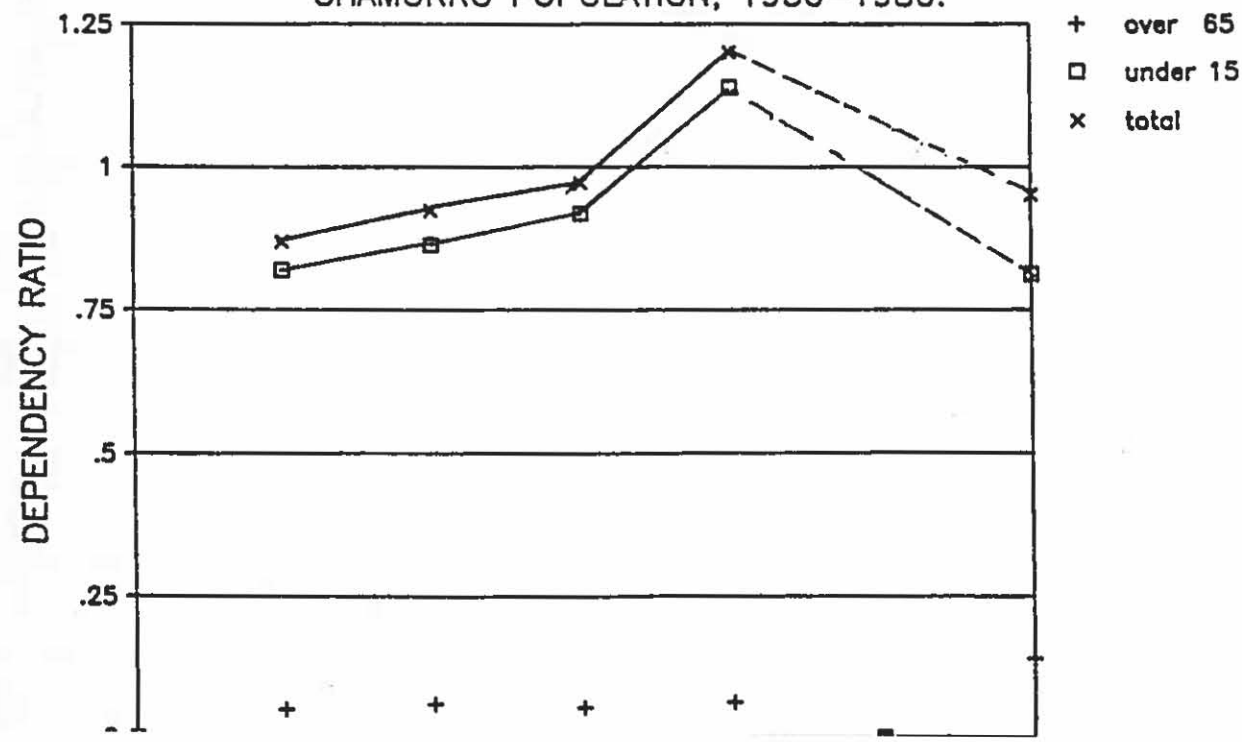


FIGURE II.10 (b)



World War. Between 1945 and 1950 an unprecedented level of population growth has occurred on Guam. This came about as the result of massive inmigration of military service personnel and guestworkers, the latter category being constituted mainly of Filipinos. As a consequence of this wave of inmigration Guam's population nearly tripled over a period of five years, leaving the Chamorro population group as a minority. The ensuing complex population composition shows increasing differentiation in patterns of population growth between the various ethnic categories in recent decades. On the one hand the Chamorro and Caucasian population groups appear to be slowing down in population growth, while on the other hand the Filipino and "Other" groups experience increasing growth in their numbers. From the age-pyramids that were presented in this chapter it can be concluded that in spite of these differences the age structure of the population as a whole is becoming more regular. At the same time, however, the proportion of people under 15 years of age is declining, while the proportion of people over 65 years of age is on the rise.

CHAPTER III - FERTILITY

Marriage

It is often assumed that a woman's fertility experience begins after she has entered into a marital union. Such an assumption may have been justified in the case of Guam when discussing the situation as it was before World War II. P(i)/F(i) ratios for the years 1960 and 1970 on this subject show the fallacy of this assumption for later years (see chapter I). It was observed that in these censuses childbirth to non-married women was ignored. Measurement of childbirth to non-married women is further complicated by the common practice of adoption. The vital registration system allows some insight into both types of events. The number of reportedly illegitimate births per 1,000 live births appears to have soared from about 10 in 1970 to 25 in 1984. The number of reported (official) adoptions fluctuates strongly over the years, but can on average be taken to represent 1-2% of all live births, without any significant upward trend. Since adoption is a well established practice in Chamorro culture, especially in the case of young, unmarried mothers, the above observations indicate a high and rising incidence of non-official adoptions.

The above serves as a warning for using indices of marriage to illustrate patterns of fertility in the case of Guam. Information on marriage in this context will therefore remain limited to one index, depicting the mean age of (first) marriage, the Singulate Mean Age of Marriage. It is based on the reported number of males and females that are single in each five-year age group, ranging from 15 to 50. It can only be computed from the censusdata for 1960 and 1980 and results for males in 24.9 and 24.5, respectively. For females these values are 20.5 and 22.1. Theoretically, a rise in age at marriage for females implies an overall lowering of fertility. Only through the use of age specific fertility measures can such a conclusion be justified, however.

Crude Birth Rates.

Throughout the period 1902-1941 the Crude Birth Rate (CBR) remained remarkably stable. Slight fluctuations that did occur typically follow some disaster, like the 1918 influenza epidemic. For the population as a whole, the CBRs reflect a high level of fertility for this period, measuring between 45 and 50 births per thousand people.

During the years of Japanese occupation the CBR dropped to between 35 and 40. Although some degree of underreporting for these years undoubtedly occurs, since this information was obtained after the war, an actual decline in fertility is more than likely. Parity for postwar years confirms this.

The rates for this period all pertain to the aggregate population. Since the Chamorro component was so prominent during these times, these rates can safely be taken to represent demographic characteristics of that population group. Moreover, separate treatment of other ethnic groups would not yield statistically meaningful results, again due to their low numbers.

The massive inmigration, especially between 1945 and 1950, influences demographic statistics considerably. Crude rates are particularly affected, since these use the whole of a population group as basis. CBRs for Guam's aggregate population since 1945 illustrate this effect. Little of a postwar baby-boom can be observed from figure III.2, since the total population grew much faster than the number of births. This effect pervades all of this figure. Its constant, smooth curve is mainly due to developments in the base population. Until 1975 the values slightly fluctuate between 30 and 35 births per thousand population. After this year a downward trend sets in, declining to about 26 in 1984. The number of births has remained fairly constant during these years, whereas the total population has increased rapidly. This curve, therefore, cannot be taken to

FIGURE III.1

CRUDE BIRTH RATES, GUAM.

AGGREGATE POPULATION, 1902–1944.

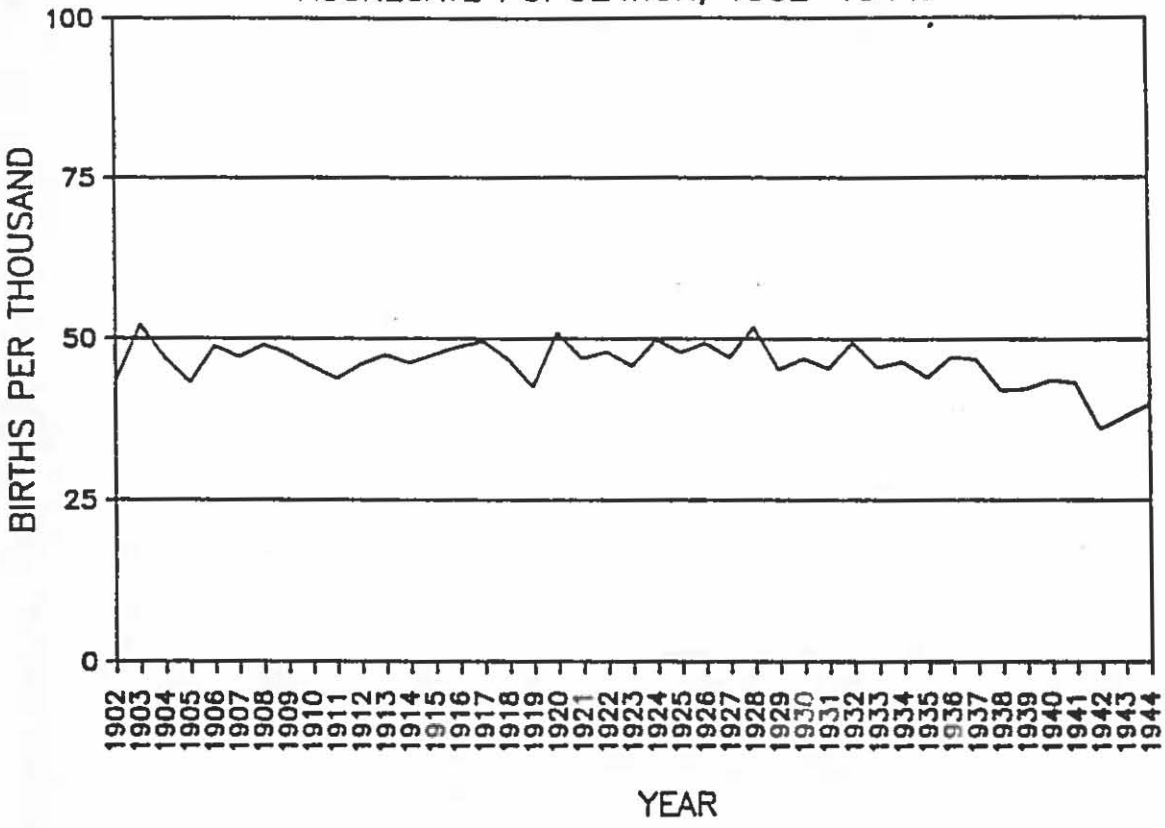
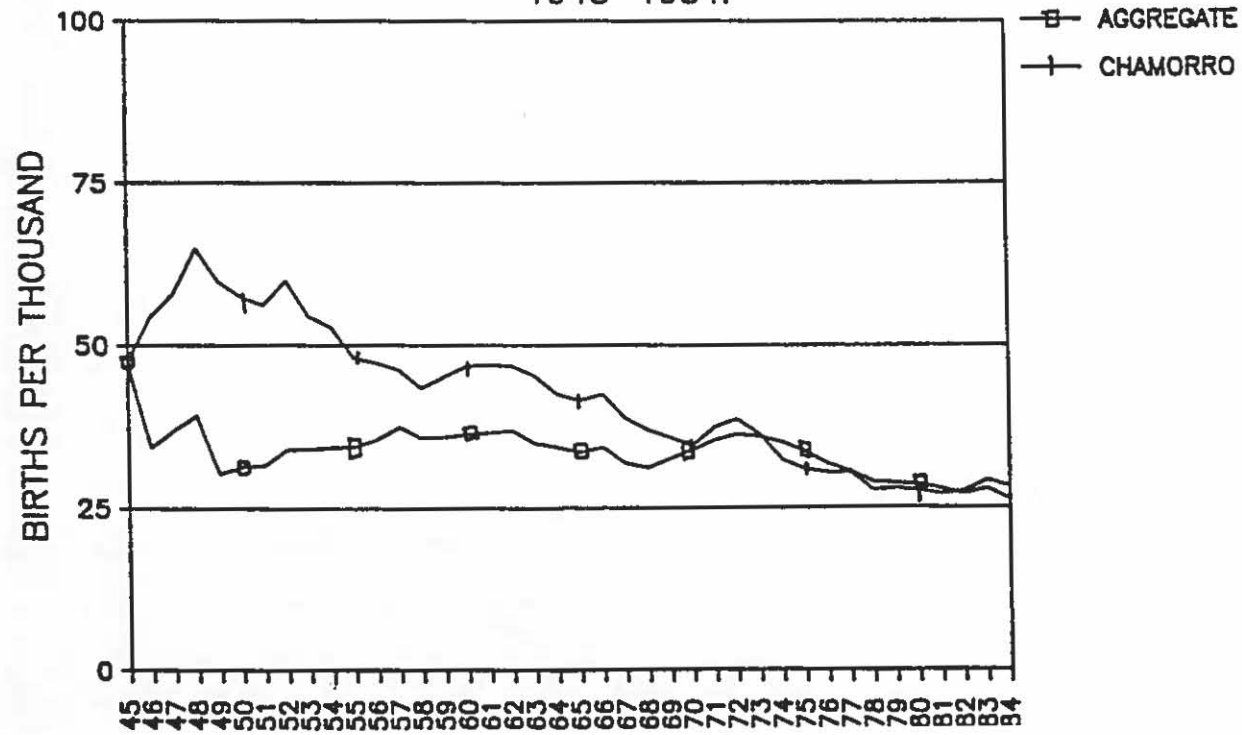


FIGURE III.2

CRUDE BIRTH RATES, GUAM.

1945–1984.



adequately indicate ongoing population trends. A breakdown by ethnicity results in a more accurate picture. Figure III.2 also shows the development in CBRs for the Chamorro component. For Chamorros, a postwar baby-boom now becomes evident: shortly after the war the curve peaks at a value of about 65 per thousand. After that a decline sets in, one that also has been noted by other writers on this subject. Since 1955, the CBR for Chamorros has fallen from 53 to about 28 in 1984.

CBRs for the other components of Guam's aggregate population reflect to greater or lesser extent the influences of their migration patterns and population composition. Especially for these groups a measure such as the CBR suffers from limitations that make it inadequate to generate unbiased comprehension of their patterns of reproduction. For this reason the curves, formed by their CBRs, are not shown.

Age Specific Fertility Measures.

Since World War II data exist in sufficient detail so as to allow the calculation of Age Specific Fertility Rates (ASFR). These are based on the female population aged 15 to 49, generally considered to represent the population subgroup that bears children. The age pattern, formed by those women within a certain age group who gave birth, during a period of one year, is considered to be strongly related to the type of fertility regime that the population experiences. A regime of "natural fertility", for example, means that childbearing begins as soon as a woman becomes fertile and is not restricted by voluntary causes such as marriage or contraception. Such a regime would result in a pattern of ASFRs that would start rising after the age at which the menarche occurs, quickly reach a high level and only very gradually taper off as involuntary causes preventing childbirth exert increasing influence. A "natural

marital fertility" regime incorporates these involuntary causes with the restriction that childbirth only takes place within marital unions. The resulting pattern of ASFRs would start off low and reach its peak at the age after which most people have entered into a marital union. As unions dissolve the ASFRs would tend to decline with increasing age at a faster pace than in the previous situation. The practice of contraception typically results in an overall lowering of AFSRs with a concentration of childbearing between the ages of 20 to 30. These very general observations may serve to elucidate the actual patterns formed by ASFRs for various population subgroups on Guam.

Figures III.3 a and b show ASFRs for the Chamorro population for the years 1950 and 1960. The 1950 values are based on births that fall well within the period during which the baby-boom took place. The overall level of fertility is high, yet compared to 1960 the age groups 20-24 and 25-29 stand out. A baby-boom often includes catching up of postponed marriages and/or childbirth. The age group 30-34 in 1950 might be expected to show such effect. The fact that the ASFR for this group in 1950 is actually lower than for the same age group in 1960 therefore seems an anomaly. It may be that these women completed their "catching-up" shortly after the war.

As there is no point in time before World War II that the 1960 data can be compared to, the earlier observation that a fertility decline amongst the Chamorro population set in between 1950 and 1960 cannot be substantiated on the basis of the present figures.

The Total Fertility Rate (TFR), which functions as a summary measure of the ASFRs, does show a rather substantial decline. The TFR signifies the number of children that a woman would bear during her lifetime if she were to respond to the same fertility regime that the TFR refers to. This may alternatively be multiplied by 1,000, as has been done in the present instance. The rise in TFR between 1950 and 1960 is somewhat surprising, but may be attributed to

FIGURE III.3 (a)

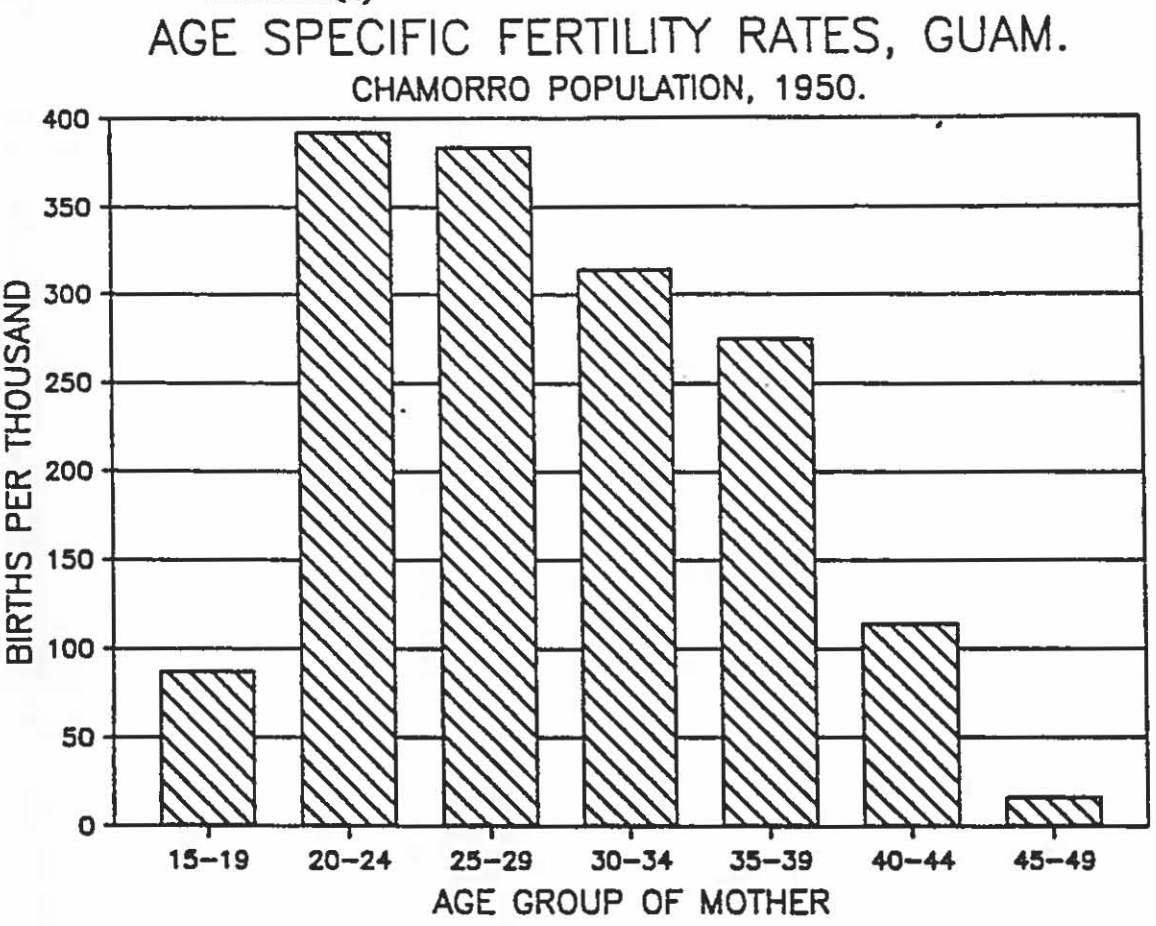


FIGURE III.3 (b)

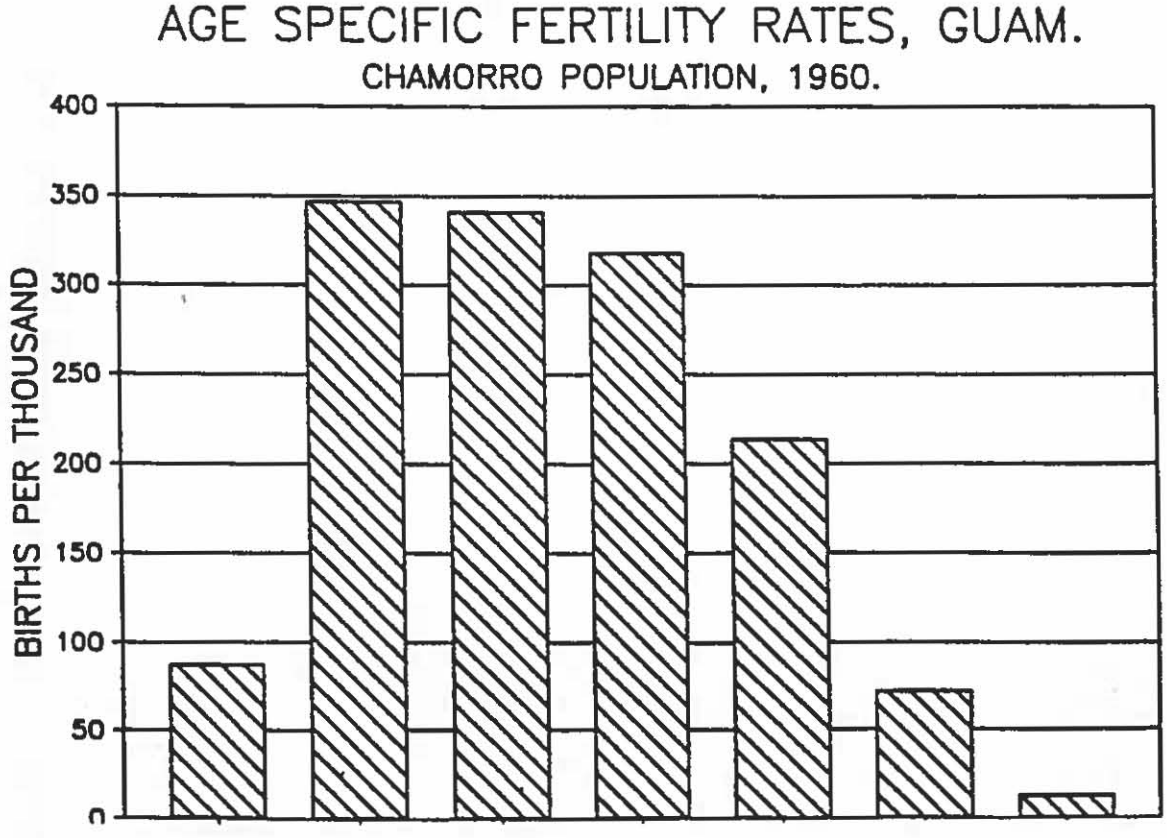


FIGURE III.4 (a)

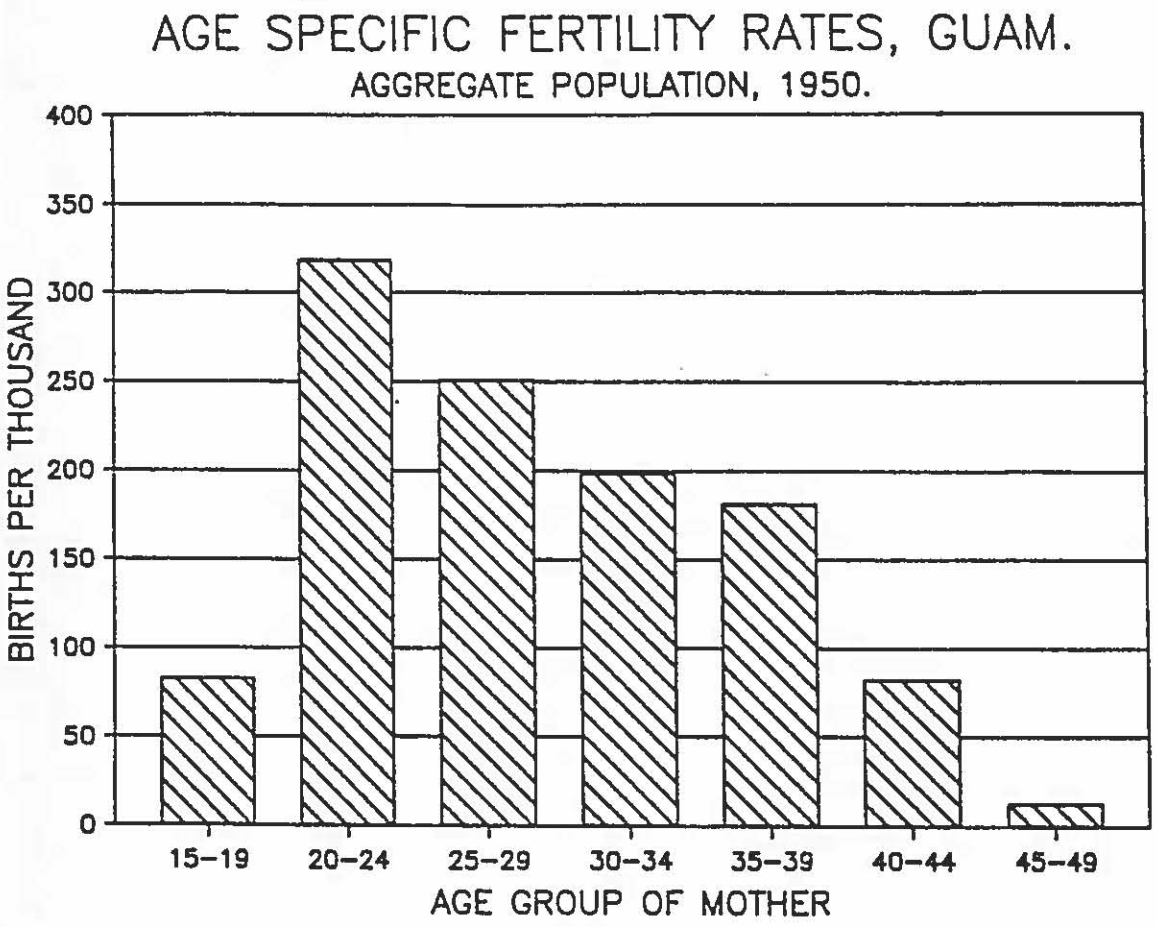


FIGURE III.4 (b)

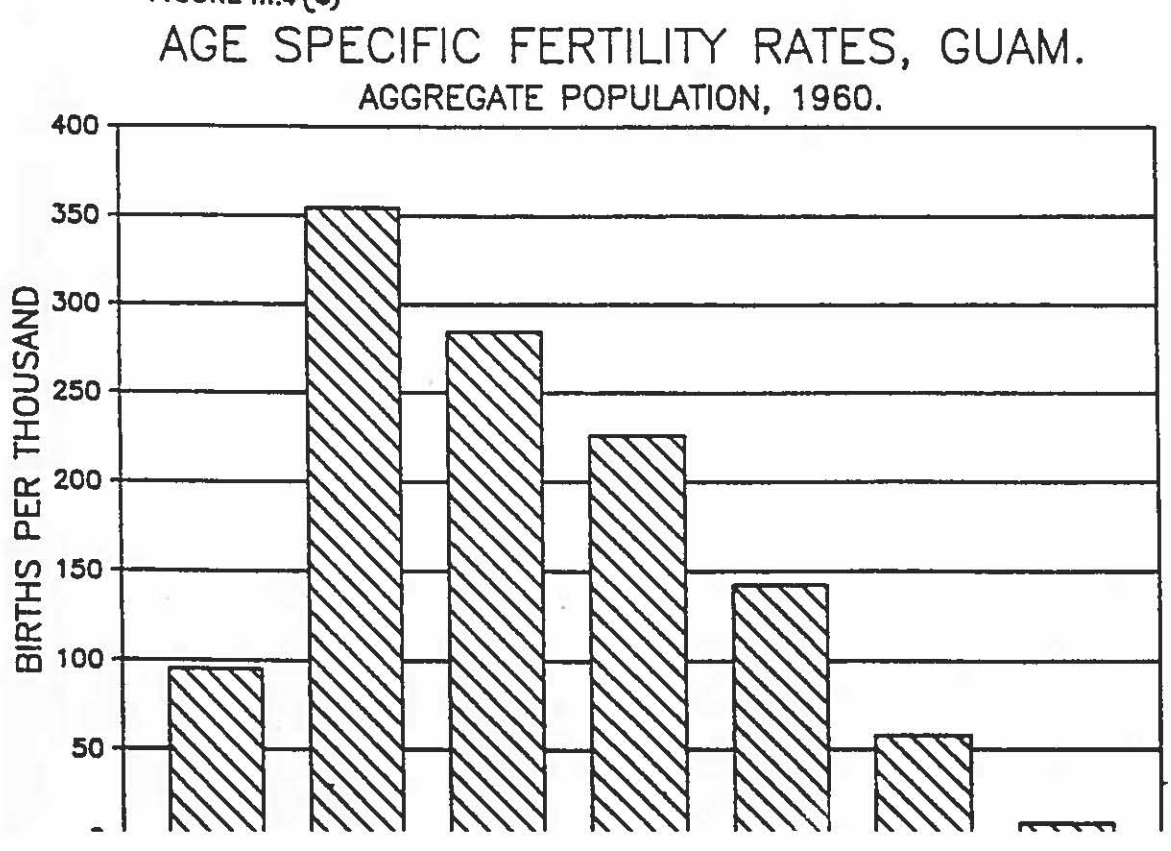


FIGURE III.4 (c)

AGE SPECIFIC FERTILITY RATES, GUAM.

AGGREGATE POPULATION, 1970.

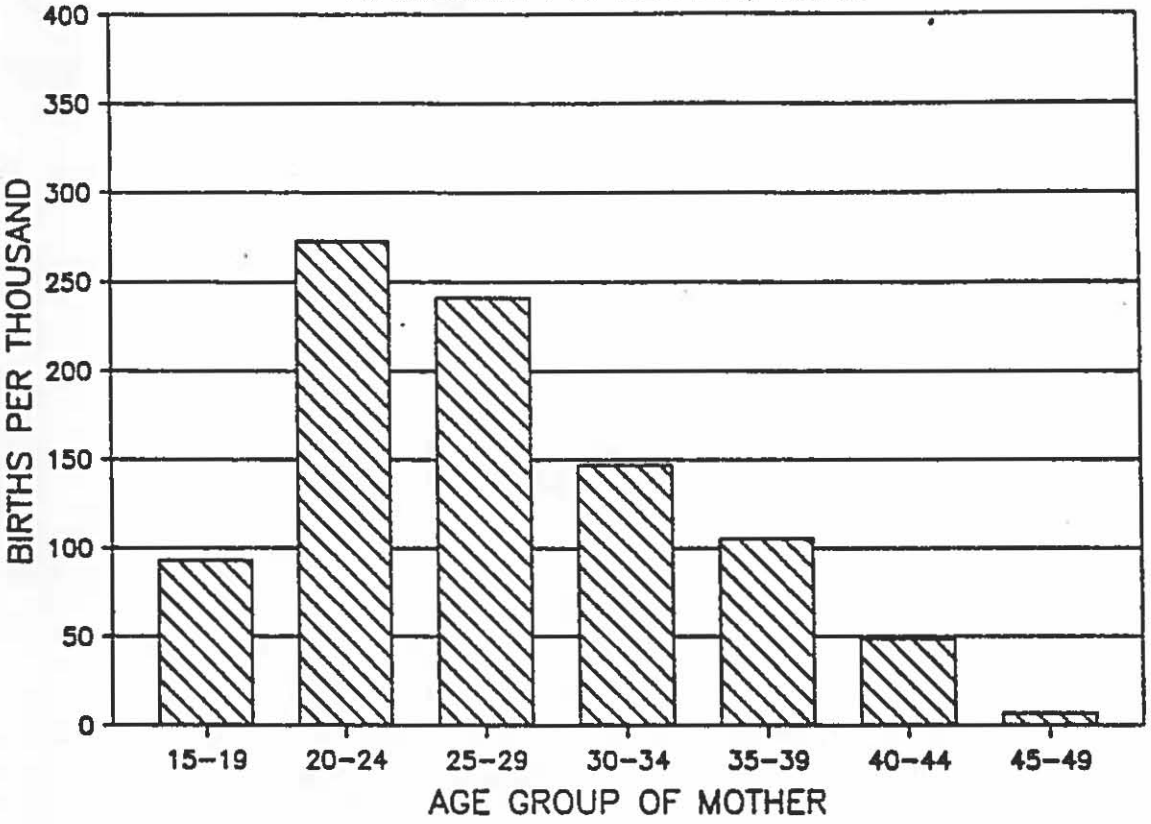
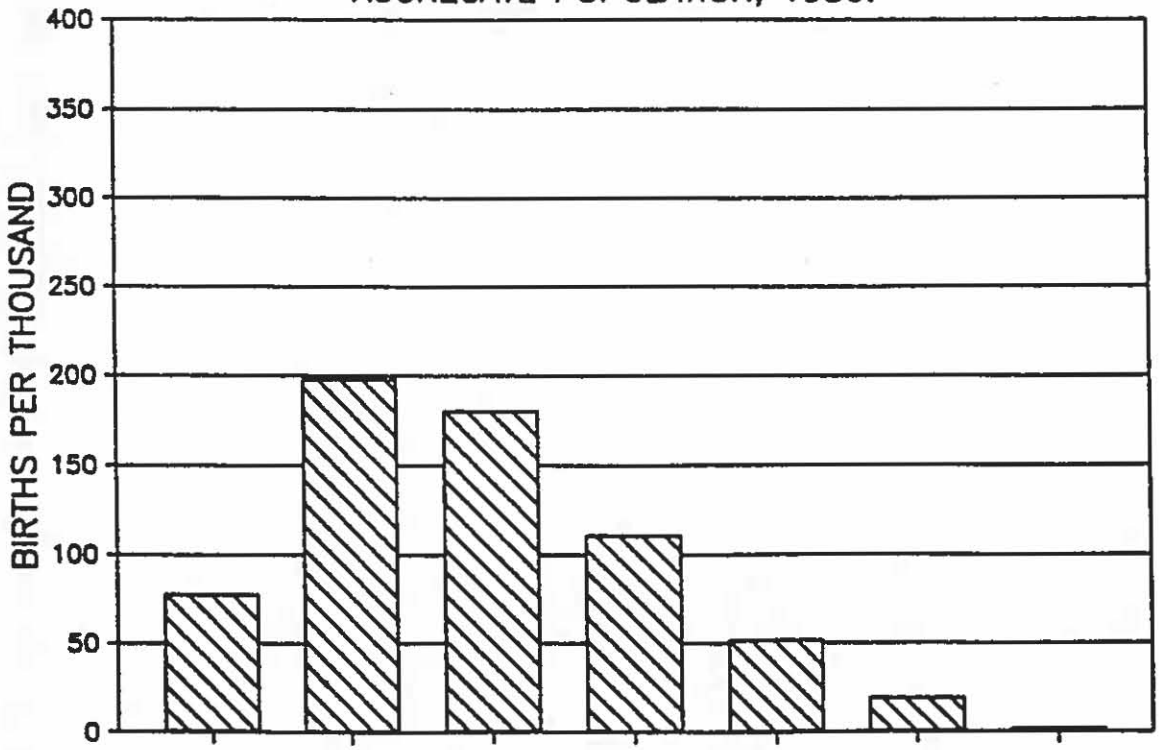


FIGURE III.4 (d)

AGE SPECIFIC FERTILITY RATES, GUAM.

AGGREGATE POPULATION, 1980.



family-forming processes among the non-Chamorro population groups. The rise in TFRs among these groups more than offsets the decline in fertility that can be observed for Chamorros over this period. Table III.1 and figure III.5 present the values referred to, as well as those for other ethnic groups.

ASFRs for the aggregate population show an opposite trend from those for Chamorros. Figures III.4 a and b indicate that women in the age range of 15-34 on average experienced higher fertility in 1960 than in 1950. Women over 35, on the other hand, show a reduction in their ASFRs over that period. The latter development stems from the fact that the recently established non-Chamorro population groups contain relatively few older women so that their contribution to the aggregate fertility pattern is negligible. The observed reduction is therefore the one observed for Chamorros. The rise in fertility for women 15-34 results from the combined influence of a near doubling of the fertility of all non-Chamorro population groups. Figure III.5 illustrates this through the use of the TFR. The ASFRs for these population groups have not been plotted. The low numbers of births per age group results in values that are subject to wide fluctuations. These are minimized by aggregating the data to TFRs.

Between 1960 and 1980 a very rapid fertility decline occurred, as figures III.4 b,c and d illustrate. Unfortunately it is not possible for this period to distinguish between the various ethnic groups. It can therefore not be ascertained in what way each group contributes to this development. Crude Birth Rates can be merely indicative in this regard, as was earlier pointed out. Figure III.6, as well as table III.1 show the rapidity of this trend.

Changes in the pattern of ASFRs can be depicted by using a measure such as the Mean or the Median Age at Childbearing (MAC). Although both the mean and the median would yield significant results, the latter is conceptually more straightforward. It determines the age of women at which exactly half of all births, taking place in a given year, have occurred. Since the lower and upper

FIGURE III.5

TOTAL FERTILITY RATES BY ETHNICITY, GUAM.
1950–1960.

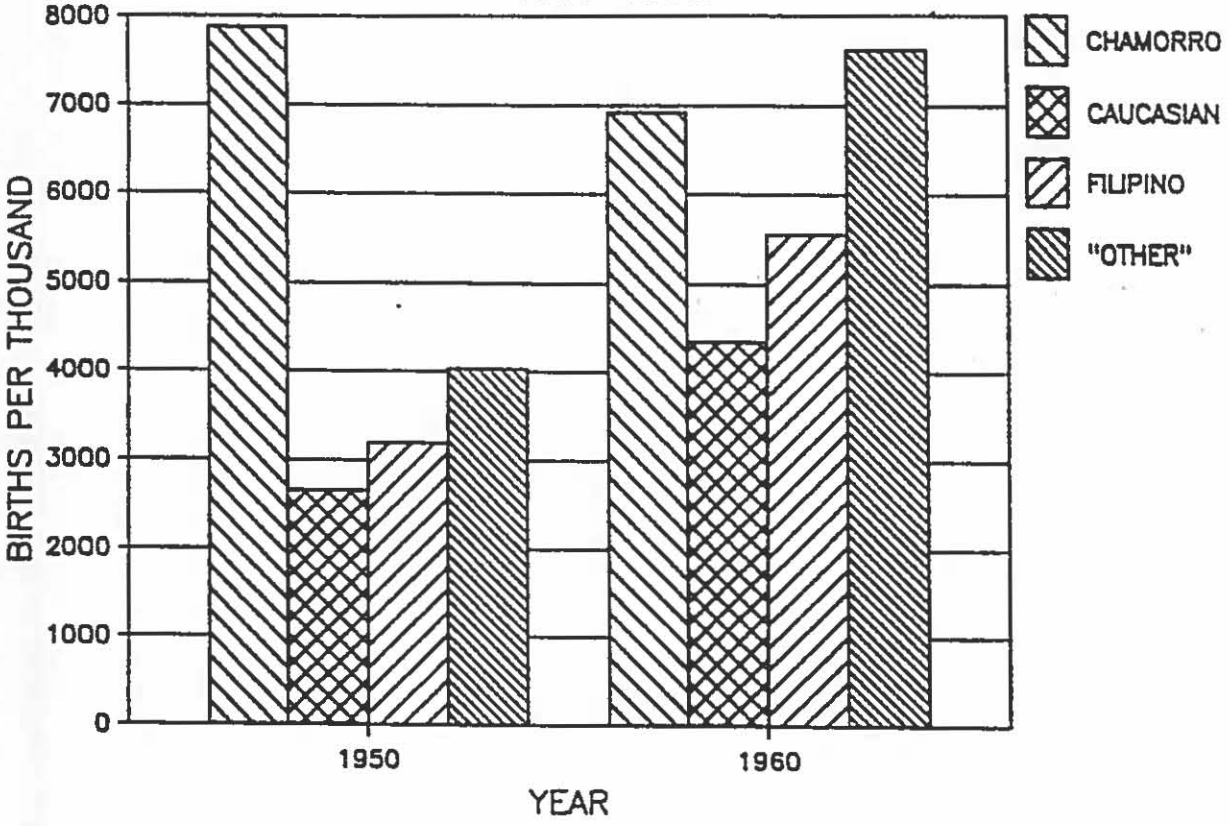
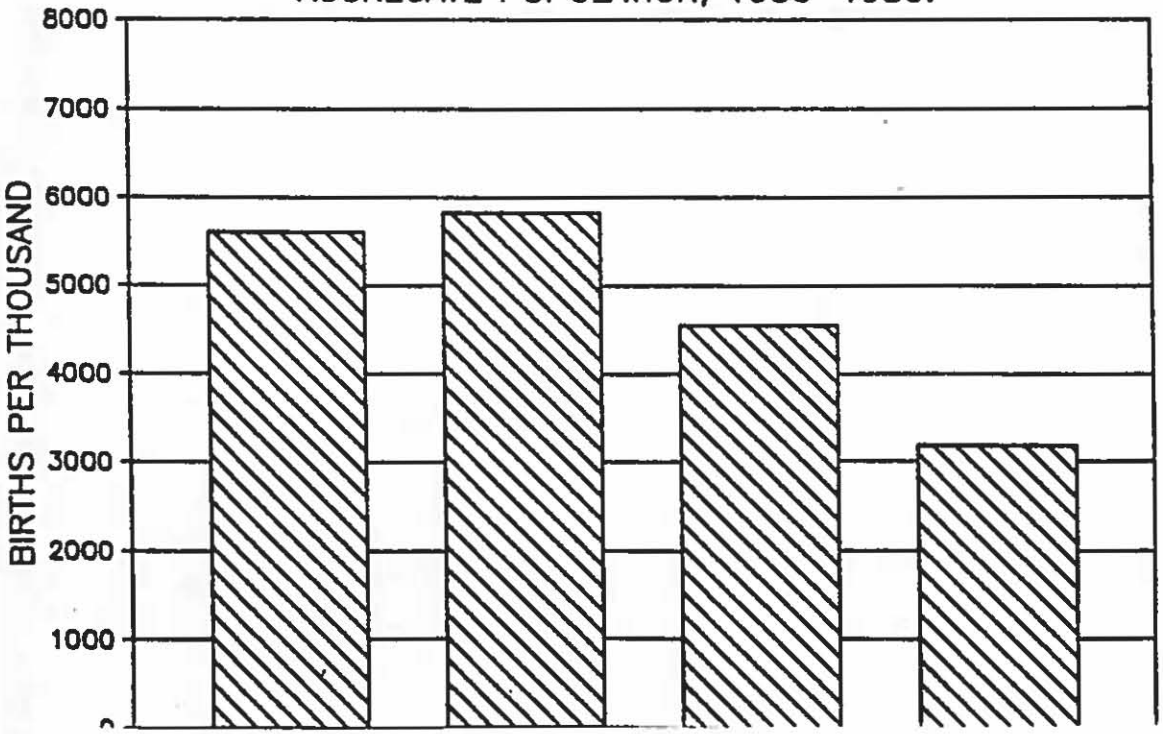


FIGURE III.6

TOTAL FERTILITY RATES, GUAM.
AGGREGATE POPULATION, 1950–1980.



boundaries of the age range are biologically determined, a lowering in the value of the MAC, for example, typically means increasing concentration of childbirth in the younger age groups. As for Guam's aggregate population, the Median Age at Childbirth does show a tendency to decline. In 1950 it amounts to 27.2, and subsequently falls to 26.8 in 1960 and 25.2 in 1970. 1980 shows a slight rise to 25.6. Since this information is being abstracted from the same basic data that is used for calculation of the ASFRs it follows that no distinction between ethnic groups is available beyond the year 1960. Low absolute numbers preclude separate treatment of any but the Chamorro population group for the years 1950 and 1960. For these years, half of the Chamorro children were born to mothers aged up to 27.1 and 27.3, respectively. The slight rise in MAC is in agreement with the observed pattern of ASFRs, which showed lesser concentration of childbirth in the younger age groups in 1960 than in 1950. Again it must be noted that the baby-boom may largely account for the observed differences between 1950 and 1960.

Reproduction Rates.

The Gross Reproduction Rate (GRR) is very similar to the Total Fertility Rate. It is also a summary measure, based on age-specific components. In this case, however, only female births are taken into consideration. The resulting measure indicates how many female children a woman would bear during her lifetime, under the assumption that her individual reproductive behavior conforms to the pattern observed for the year the data refer to.

Closely related to this measure is the Net Reproduction Rate (NRR). This one only differs from the GRR insofar that it takes the mortality experience of the mothers into account. The GRR assumes that all women would survive during their childbearing years. Obviously, this results in a certain degree of overstatement, depending on the level of mortality that the population under consideration

experiences. The NRR takes the proportion of mothers that will die into account by employing a survivorship measure, taken from an appropriate life table. The present series of NRRs, tabulated in table III.2, has been arrived at using life tables for the female aggregate and Chamorro population for the relevant years. NRRs for the rest of the ethnic groups are estimated on the basis of the life table for the aggregate female population, since no life table for these migrant groups can be developed (see also chapter IV). Values for 1970 are based on the additional assumption that the sex-ratio at birth amounts to 1.06. Two conclusions can be drawn from table III.2 and figure III.7; first, the trend closely resembles the one in TFRs, second, the difference between GRR and NRR is steadily decreasing. It may further be noted that a NRR of 1.0 means that the population has reached the so-called "replacement level". This means that, in the absence of migration, the population eventually would stop growing, and attain a constant size and composition. This represents a special form of the stable population, the so-called "stationary population". The NRR for the aggregate population for 1980 is 1.5. If the fertility decline would continue at the rate it did for the decade 1970-1980, replacement level would be reached in the year 1990. A stationary situation is very unlikely to arise, however, because of the prominence of migration.

Parity Information.

In chapter I information on Children Ever Born was compared to the fertility experience of women during the year ending at the time of census. The level of the resulting P(i)/F(i) Ratio was used as being indicative of the quality of reporting of the former variable. Its pattern discloses information on both quality of reporting and actual fertility trends. Figure I.5 can now be used for the latter purpose. Although parity information is available only since 1960, it

TABLE III.1
TOTAL FERTILITY RATES, GUAM 1950-1980.

YEAR	AGGREGATE	CHAMORRO	CAUCASIAN	FILIPINO	"OTHER"
1950	5601.8	7871.7	2653.1	3193.3	4029.1
1960	5820.2	6918.4	4345.3	5546.0	7613.0
1970	4545.6	*	*	*	*
1980	3176.6	*	*	*	*

Note:
* not available

TABLE III.2
REPRODUCTION RATES, GUAM 1950-1980.

MEASURE	YEAR 1950	1960	1970	1980
AGGREGATE POPULATION				
G.R.R.	2.6597	2.7472	2.2149	1.5408
N.R.R.	2.3827	2.6436	2.1338	1.4977
CHAMORRO POPULATION				
G.R.R.	3.7749	3.1606	*	*
N.R.R.	3.3076	2.9926	*	*
CAUCASIAN POPULATION **				
G.R.R.	1.1906	2.2604	*	*
N.R.R.	1.0790	2.1816	*	*
FILIPINO POPULATION **				
G.R.R.	2.2000	3.0359	*	*
N.R.R.	1.9617	2.9275	*	*
"OTHER" POPULATION **				
G.R.R.	1.3168	3.3393	*	*
N.R.R.	1.1644	3.2131	*	*

Notes:
* not available
** using survival rates from life table aggregate population.

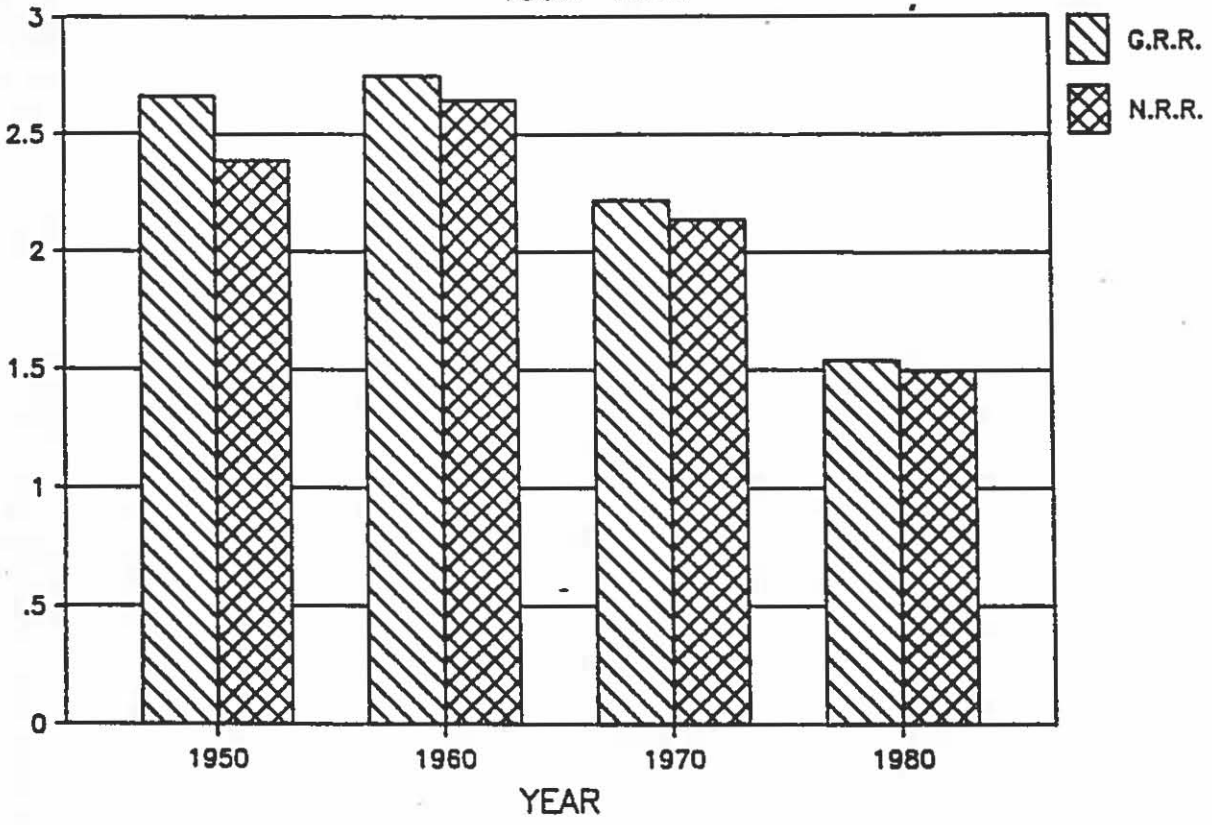
TABLE III.3
P(i)/F(i) RATIOS, GUAM 1960-1980.

AGE	CHAMORRO 1960	AGGREGATE 1960	1970	1980
15-19	.6376	.7316	.6526	.9313
20-24	.7917	.8249	.8271	.9468
25-29	.9451	.8044	.8969	.8872
30-34	.9707	.7953	.9244	.9518
35-39	.8704	.7290	1.0019	1.0845
40-44	.7809	.7020	1.0614	1.2868
45-49	.8814	.7854	n.a.	1.4444

FIGURE III.7

REPRODUCTION RATES, GUAM.

1950–1980



can provide information on developments up to several decades before that date, since the variable CEB involves an accumulation through time.

The P(i)/F(i) Ratios for the Chamorro population in 1960 do not show a particular trend (table III.3). It can be observed that women aged 35-49 in 1960 have experienced less-than-average childbirth, indicated by P(i)/F(i) Ratios that are way below unity. Their age range strongly suggests that this is due to the influence of World War II, since these women were 15 to 29 years of age in 1940. A notable dip in the age group 40-44 (20-24 in 1940) serves to strengthen this inference. For 1960 the values for the aggregate population differ slightly from the values for Chamorro. For the ages under 25 the values for the aggregate population are higher than for Chamorros while for other ages the reverse is true. This may partly be attributed to the fact that about 5% of Chamorro women aged 15-49 were childless in 1960 versus 15% for women of the combined other groups. Furthermore, the family forming processes among immigrants who are establishing themselves, mentioned above, may account for the differences among those women who were younger than 25 in 1960. The 1970 and 1980 values strongly support the notion of a fertility decline. The rise in P(i)/F(i) Ratios also indicates that this decline has been more pronounced between 1970 and 1980 than between 1960 and 1970.

Conclusion.

The fertility regime of the Chamorro population during the first half of this century is characterized by high and constant fertility. Crude Birth Rates, the only measures available for this period, indicate a level of nearly 50 births per thousand population. After a drop in these rates, caused by World War II and its aftermath, CBRs reached an unprecedented peak of about 65 per thousand, constituting a postwar baby-boom. This lasted until the early 1950s, after which

the level of fertility started dropping at an increasingly fast pace. This drop made CBRs for the Chamorro population tumble to about 26 per thousand at present. Total Fertility Rates for the Chamorro population for 1950 and 1960 agree with this pattern, amounting to 7.9 and 6.9 respectively.

As far as all other ethnic groups are concerned it can be noted that their fertility patterns tend to be related to the pattern of migration. In the case of Filipinos and "Others", for example, it can be observed from the available statistics that level of fertility tends to rise during a period of inmigration of females of the ethnic group under consideration.

The decline in fertility is also reflected in statistics pertaining to the aggregate population, for which age specific measures are available that cover the whole postwar period. Total Fertility Rates indicate a drop from 5.8 in 1960 to 3.2 in 1980. The age pattern of women that give birth shows accompanying changes. It can be observed that childbirth tends to become increasingly concentrated within the age group of 20-30 years, resulting in a drop in the Median Age at Childbearing from 26.8 in 1960 to 25.6 in 1980. It may further be noted that the relative contribution of females aged 15-19 years to the number of births tends to increase, since this age group hardly partakes in the decline in fertility.

CHAPTER IV - MORTALITY

Crude Death Rates.

Before World War II the pattern of mortality that had taken such heavy toll in earlier centuries still prevailed. Figure IV.1 shows a curve with several extreme peaks. These signify epidemics that continued to occur frequently, although they no longer decimated the population. The first peak that can be noted in figure IV.1 occurs in 1905 and results from a typhoon that struck Guam in that year. Mortality generally remained high and constant during the first twenty years of U.S. administration on Guam. Some improvements in sanitary conditions were undertaken, starting in 1910, the effects of which could be noted in later years. The introduction of piped water to the, then, densely populated city of Agana in 1910 initiated a slow decline in the Crude Death Rate (CDR). This trend is largely obscured by a series of epidemics, starting with the 1918 influenza epidemic, which caused 853 deaths (Haddock, 1973). Less severe were epidemics of bacillary dysentery in 1924, measles in 1932 and 1934 and whooping cough in 1938. Each of these caused around 150 deaths. In spite of this, the CDR pertaining to Guam's aggregate population dropped from about 25 to approximately 20 deaths per thousand population. This measure strongly reflects trends among the Chamorro population since the number of deaths occurring to the low numbers of (young and generally healthy) non-Chamorros is virtually negligible.

The years of Japanese occupation require special mention. As was pointed out earlier, registration of births and deaths resumed immediately after the war. Information on vital events that had occurred during the war was gathered from those who survived, on a retrospective basis. This procedure, although better than nothing, has undoubtedly resulted in a serious degree of underregistration for these 2.5 years, including deaths that occurred during the liberation of

FIGURE IV.1

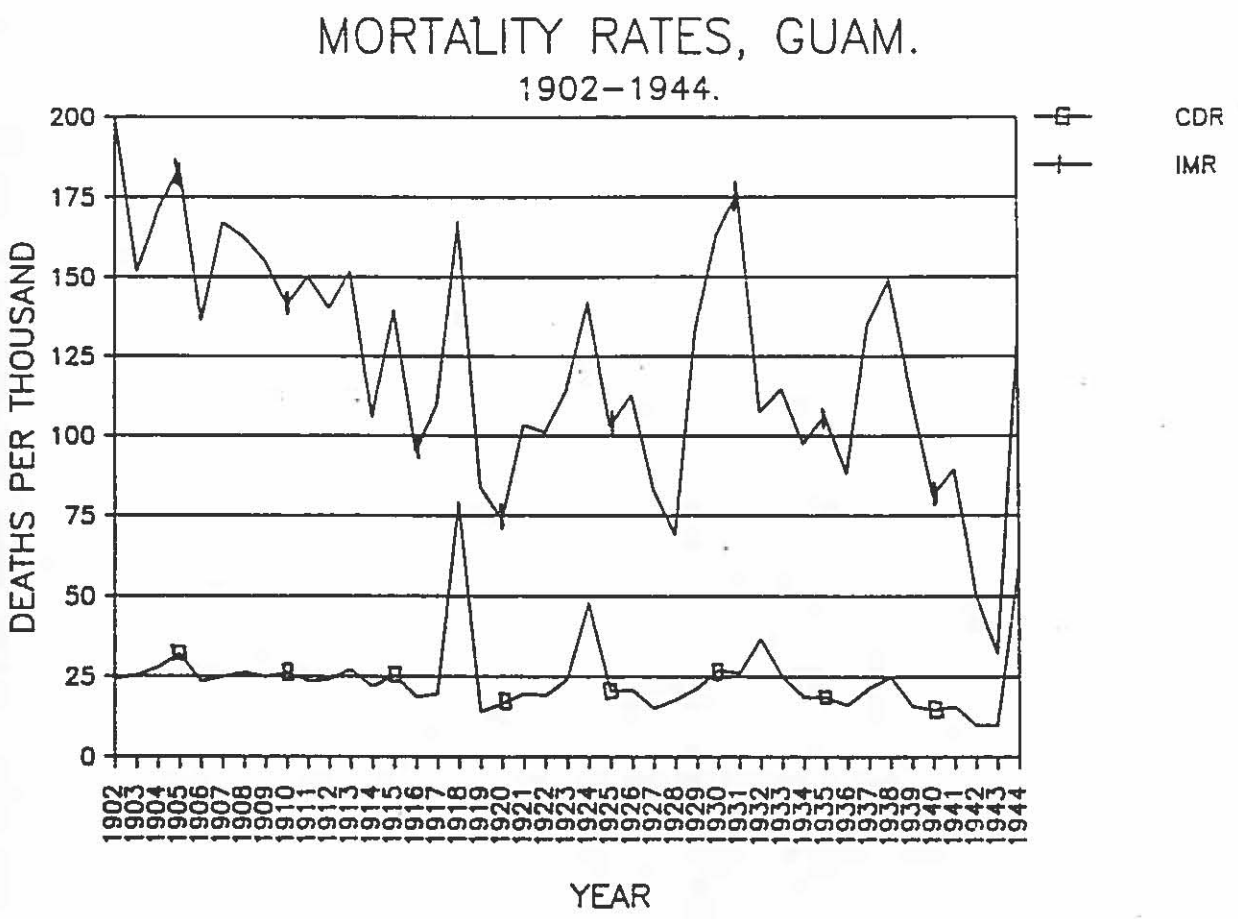
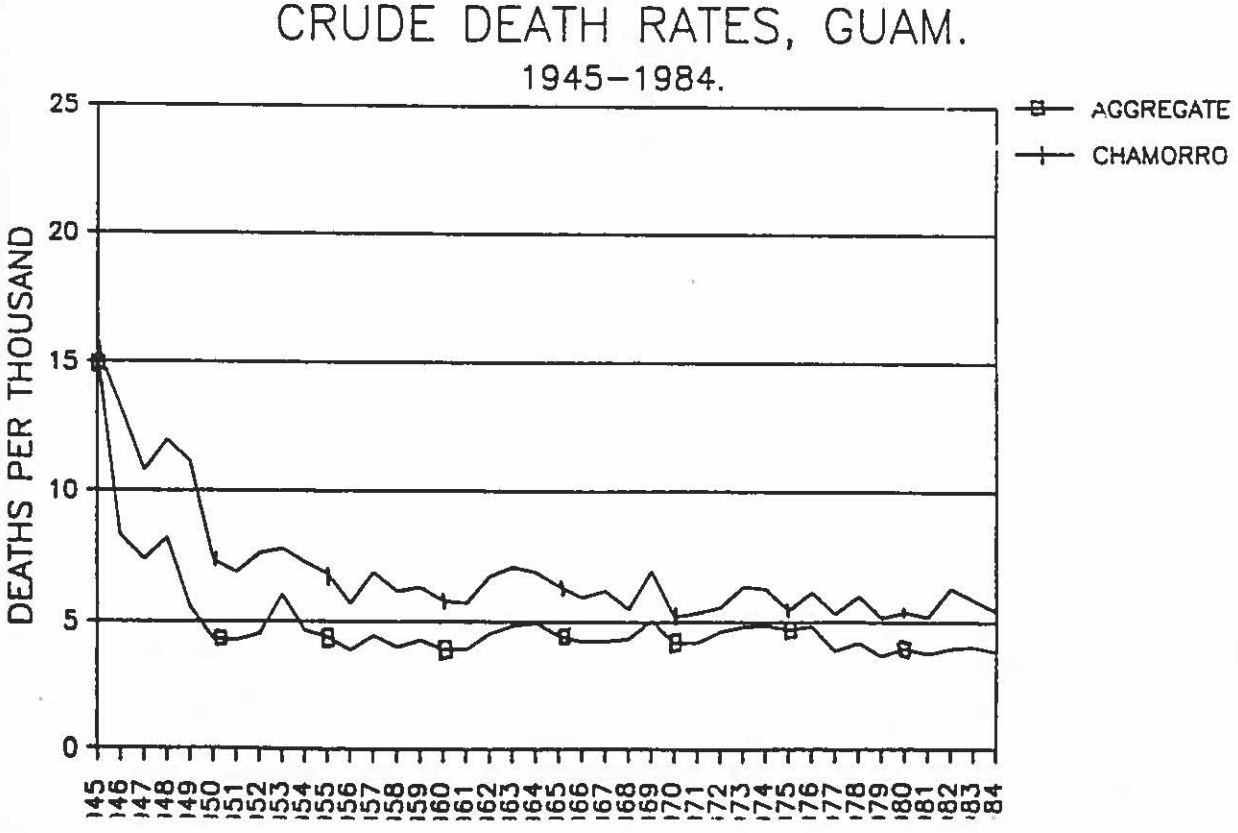


FIGURE IV.2



Guam. Deaths for July and August 1944 have been reported and can be found in death records up to 1950. They accumulate to a total of 1,342 for the year 1944, about 1,100 of which for those two months only.

Guam's liberation caused a devastation of its buildings and infrastructure. The Japanese occupation had left Guam's population severely undernourished. Until two years after the liberation large parts of the population were forced to live in refugee camps. Dysentery and hookworm disease often proved fatal under these circumstances. Shortly after the war, the naval authorities started the rebuilding according to new designed plans. The ensuing process of massive land transfers and relocation of its former occupants left the city of Agana almost deserted. The final result undoubtedly was favorable to sanitary conditions and, in combination with massive vaccinations, prevented epidemics as severe as those that had taken place in earlier periods.

Again, it must be noted that the massive inmigration after World War II distorts demographic statistics for this period, unless they are subdivided into more homogeneous segments. Figure IV.2 shows CDRs for Guam's aggregate population that, especially after 1950, are constant and low. The Chamorro population follows the same pattern, although on a higher level. The mortality decline that had set in before World War II does not show any further development beyond the year 1950. CDRs for Chamorros since then have fluctuated slightly between 5 and 6 per thousand. The values for the Caucasian and Filipino population groups agree with the description of these groups as "young and generally healthy"; they fall within the range of 2 to 3 per thousand. Again, however, their curves have not been plotted because chance variation precludes the determination of any trend.

Infant Mortality.

Also plotted in figure IV.1 is a curve depicting Infant Mortality Rates for the first part of this century. These values fluctuate widely which is partly due to low absolute numbers in the numerator of this rate, the number of children who die before they reach the age of one year, as in the denominator, the number of live births during the year. Although this affects the reliability of the data, some conclusions can be drawn. The IMRs appear to reflect the above mentioned influences during the pre-war period in an even more extreme way. Since the IMR is a good indicator of the overall mortality level, its downward trend that can be observed in figure V.1 strongly suggests that mortality has been improving during most of this period.

After World War II this relationship remains evident; the decline in IMRs for the aggregate and the Chamorro population in figure IV.3 can be noted to persist well into the present, dropping from over 30 per thousand live births in the 1950s to about 10 in recent years. Although CDRs for this period show hardly any development, the IMRs suggest that the overall mortality level kept on improving until recently. The dip that shows for 1951 is caused by underregistration, resulting from the change in administration that had taken place toward the end of 1950. No graph for any of the other ethnic groups has been plotted, because of wide fluctuations in the low numbers of infant deaths.

Age Specific Mortality Rates.

Subdividing mortality data into five-year age groups, for each sex, clearly indicates fundamental changes in the pattern of mortality that took place between 1920 and 1980. The small number of events in each age group once more causes the warning to study the pattern and the general level rather than take individual

FIGURE IV.3

INFANT MORTALITY RATES, GUAM.

1945–1984.

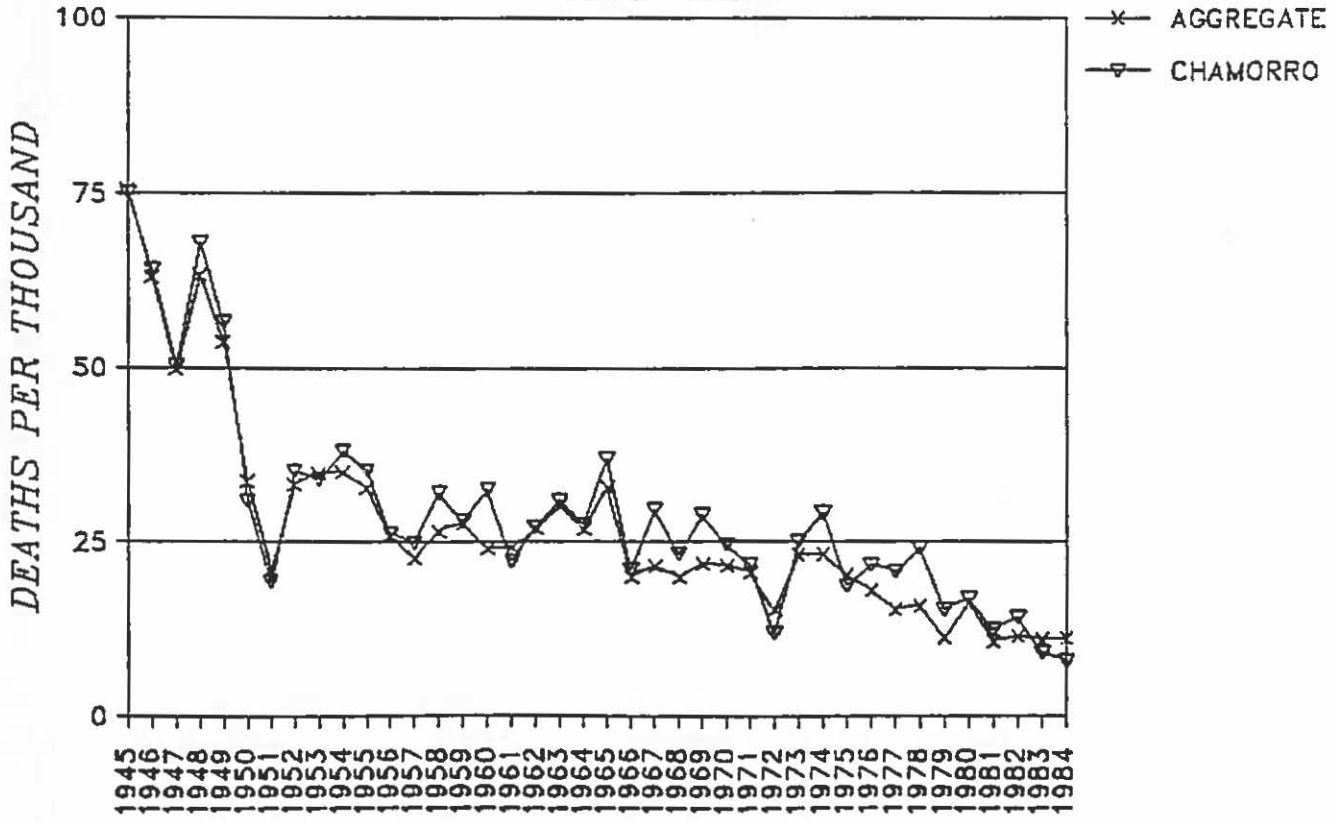


TABLE IV.1
AGE SPECIFIC MORTALITY RATES, GUAM.
AGGREGATE POPULATION, 1920-1980.

MALES AGE GROUP	YEAR 1920	1930	1940	1950	1960	1970	1980
< 1	138.89	191.81	109.81	60.93	30.97	31.09	13.61
1- 4	59.54	47.84	12.52	4.50	1.35	1.63	.71
5- 9	13.12	5.13	2.11	1.17	.58	.44	.36
10-14	4.39	1.53	1.14	.47	.63	.87	.34
15-19	11.80	3.48	1.83	.84	1.75	3.94	1.31
20-24	11.97	5.00	6.03	1.18	2.28	2.66	2.16
25-29		4.10	4.46	1.47	1.28	2.33	2.12
30-34	12.92	5.21	7.13	1.92	2.14	2.54	2.33
35-39			11.27	3.51	1.45	2.86	1.77
40-44	30.44	10.52	17.86	4.30	3.99	5.71	3.90
45-49			18.24	9.66	7.32	5.93	7.37
50-54	52.08	17.24	26.67	10.93	12.23	11.49	10.87
55-59			18.76	11.76	19.73	20.69	14.08
60-64	112.47	28.60	33.50	28.81	29.06	38.13	26.79
65-69	351.45		56.02	38.22	43.35	40.12	35.67
70-74		59.30	72.29	55.56	48.43	89.58	42.52
75+		147.06	173.71	98.64	142.16	83.33	86.49

FEMALES AGE GROUP	YEAR 1920	1930	1940	1950	1960	1970	1980
< 1	149.32	171.01	104.79	48.49	26.64	17.26	15.08
1- 4	55.82	47.50	14.08	3.31	1.20	1.36	.54
5- 9	12.00	5.50	1.53	.77	.66	.35	.32
10-14	4.04	2.51	1.22	1.36	.56	.47	.12
15-19	11.51	4.94	2.93	2.74	.34	.68	.71
20-24	13.27	10.17	6.77	3.02	.75	.92	.66
25-29		12.03	5.68	1.63	1.22	.70	.97
30-34	21.60	6.69	9.90	3.86	.48	.63	.53
35-39			10.31	4.75	1.95	1.36	1.63
40-44	20.80	10.28	9.80	5.91	3.79	2.09	1.53
45-49			8.13	9.99	5.28	5.98	1.82
50-54	44.28	18.30	8.92	11.03	9.05	5.49	5.73
55-59			16.05	12.20	7.56	13.19	8.85
60-64	102.47	22.36	24.01	22.22	17.28	17.58	13.42
65-69	267.68		25.19	28.22	23.53	26.48	26.12
70-74		49.26	65.62	44.44	58.44	52.36	38.37
75+		68.63	152.10	77.78	86.36	94.87	80.87

cells at face value. The problem of chance variation has been lessened by aggregating the data for three consecutive years, centering around the exact point in time the census was held, and using three times the census population as base population. In addition, tabulations are only presented for the Chamorro and aggregate population. Major fluctuations that still occur in the Age Specific Mortality Rates (ASMR), especially in the extreme age groups, can be attributed to the inclusion of epidemics or other extraordinary events within the three year period that serves as time reference frame.

The values for 1920 in table IV.1 a particularly suffer from an upward bias, due to the inclusion of deaths resulting from the influenza epidemic that swept Guam in November and December of 1918. It must be noted that the bias is not as strong as might be expected, since it is partly compensated by the extremely low mortality that characterizes the vital statistics for 1919 and 1920. Relatively low mortality can still be noted from the ASMRs in 1930 for the higher age groups. Around 1940 a similar situation, though less dramatic, exists as the result of an epidemic of whooping cough in 1938. For 1970 some deviations from the general pattern of mortality decline appear that can be attributed to deaths among persons returning from Vietnam, many of whom were hospitalized on the island.

In percentages the age group 1-4 has experienced the biggest drop of all. Between 1920 and 1980 mortality for children aged 1-4 has dropped an astonishing 99%. All other age groups, but particularly those below 20 for males and below 45 for females have undergone dramatic declines in mortality. For females this improvement is demonstrated in the childbearing ages. From table IV.1 it can be observed that until 1960 female mortality between the ages 15 and 40 was higher than for males in that age range. Between 1950 and 1960 this situation appears to have become reversed. Better health care around the time of child delivery undoubtedly contributes to this change. It may further be noted that the bulk of

TABLE IV.2
AGE SPECIFIC MORTALITY RATES, GUAM.
CHAMORRO POPULATION, 1930-1960.

MALES AGE GROUP	YEAR 1930	1940	1950	1960
< 1	199.22	116.71	64.69	36.17
1- 4	51.65	13.36	5.97	1.73
5- 9	5.29	2.30	1.52	.44
10-14	1.66	1.23	.18	.86
15-19	4.29	2.01	1.69	1.49
20-24	7.62	7.95	2.67	2.61
25-29	5.55	5.41	2.54	3.46
30-34	6.59	8.57	4.47	3.56
35-39		13.31	7.04	1.90
40-44	12.50	20.36	10.10	8.46
45-49		20.09	19.09	16.57
50-54	20.45	29.63	17.76	19.27
55-59		21.78	17.42	27.78
60-64	31.37	36.61	35.19	35.37
65-69		60.90	39.51	47.62
70-74	66.21	78.95	63.73	45.31
75+	178.57	186.87	103.70	125.73

FEMALES AGE GROUP	YEAR 1930	1940	1950	1960
< 1	181.72	111.41	50.38	32.38
1- 4	51.47	15.20	4.56	1.84
5- 9	5.37	1.65	1.00	.88
10-14	2.72	1.33	1.54	.63
15-19	4.93	3.13	3.08	.22
20-24	10.40	6.98	3.87	.75
25-29	13.08	6.25	2.38	.92
30-34	7.36	10.99	5.45	.33
35-39		11.30	6.26	3.97
40-44	11.01	10.24	8.24	5.72
45-49		7.71	11.59	5.15
50-54	18.80	9.26	10.75	9.82
55-59		16.60	13.16	8.26
60-64	22.27	23.39	22.22	18.02
65-69		26.10	29.14	25.00
70-74	50.00	68.31	42.74	61.64
75+	69.65	158.25	77.63	89.61

the decline has taken place between 1940 and 1950, which implies that it is related to the developments on Guam that were mentioned in the first paragraph of this chapter.

Although generally on a higher level, the Chamorro population shows a development that is similar to the aggregate population (table IV.2). This is in agreement with the earlier observation that the Caucasian and Filipino population groups experience lower than average mortality.

Life Tables & Life Expectancy.

Various ways of deriving abridged life tables have been developed over the last 30 years. "Abridged" here means that the life table is constructed from grouped data, such as five-year age groups. The shortcuts that are employed basically differ in the way that Age Specific Mortality Rates, such as in the above paragraph, are being converted into a "probability of dying". The conversion employed in the present instance, proposed by Barclay, is known to generate values for "probability of dying" that are close approximations to the theoretical exact matching values.

For generating a life table, demographic data as used in the above two paragraphs are needed. After various conversions the three most important resulting parameters are: (n)q(x), the probability of dying between the ages (x) and (x)+(n); l(x), the number of persons at age (x) who have survived from an initial cohort of 100,000; e(x), the number of years that an individual may expect to live from age (x) onwards. The latter two parameters are tabulated in tables IV.3 and IV.4 for the aggregate and Chamorro population respectively.

An important result from a life table is the life expectancy at birth, or e(0). This parameter typically has a somewhat higher value for females than for males. In modern western societies the e(0) for females can be as high as 80

years. The e(0) values for Guam's aggregate and Chamorro population are summarized in table IV.5 and plotted in figures IV.4 a and b. It must again be noted that the values for 1920 are lower than might be expected because of the 1918 influenza epidemic. All series of life expectancy values plotted in these figures show rapid improvement until 1960, and thereby substantiate the earlier observation that a decline in mortality took place over this period. The lower value for males in 1970 is largely caused by an unusually high proportion of deaths occurring in age groups between 15 and 45. As mentioned earlier, this excess can be attributed to the inclusion of Vietnam War casualties. It can further be observed that the difference in life expectancy between females and males has been increasing; mortality among females appears to continue decreasing since 1960, whereas the male mortality decline shows signs of stagnation. The difference between males and females in this regard is more pronounced for the Chamorro population than for the aggregate. This becomes most notable after World War II.

Stable Population Analysis.

The results from the stable population analysis in chapter I can also be put to use in the present context. Since the values for life expectancy at birth for the stable population were derived on the basis of survival ratios for a ten-year period between two censuses it follows that, theoretically, the resulting e(0) values refer to the midpoint of that interval. In the present situation this means April 1st. 1935, 1945 and 1955, respectively. Each age/sex group generates one e(0) estimate. The range of these values for each sex and time reference point, as well as the median value, has been plotted in figure IV.5. From this figure it will be clear that the 1955 values may be disregarded, since the assumption of stability no longer holds. The low 1945 values may be taken to

TABLE IV.3
SELECTED LIFE TABLE VALUES

(a) AGGREGATE POPULATION, 1920

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	30.94	100,000	31.14	100,000	30.99
1- 4	88,891	33.76	87,868	34.40	88,383	34.02
5- 9	69,974	38.35	70,219	38.54	69,979	38.44
10-14	65,529	35.78	66,129	35.77	65,714	35.77
15-19	64,106	31.52	64,808	31.45	64,343	31.48
20-24	60,431	28.29	61,183	28.16	60,701	28.22
25-34	56,920	24.88	57,255	24.92	56,981	24.90
35-44	50,010	17.62	46,093	19.75	47,905	18.67
45-54	36,797	12.16	37,407	13.17	36,989	12.71
55-64	21,592	7.20	23,845	7.82	22,728	7.54
65+	6,049	2.85	7,688	3.74	6,873	3.40

(b) AGGREGATE POPULATION, 1930

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	42.70	100,000	43.36	100,000	43.10
1- 4	84,275	49.61	85,551	49.63	84,892	49.71
5- 9	69,555	55.68	70,707	55.63	70,111	55.77
10-14	67,793	52.06	68,790	52.11	68,273	52.21
15-19	67,277	47.45	67,933	47.73	67,590	47.71
20-24	66,116	43.23	66,277	43.86	66,204	43.66
25-29	64,482	39.27	62,991	41.02	63,881	40.15
30-34	63,174	35.03	59,314	38.41	61,454	36.64
35-44	61,550	30.89	57,362	34.63	59,670	32.66
45-54	55,401	23.76	51,753	27.84	53,768	25.70
55-64	46,607	17.30	43,075	22.44	44,988	19.74
65-74	34,946	11.40	34,411	16.84	34,956	13.96
75+	18,961	6.80	20,810	14.57	20,150	10.55

(c) AGGREGATE POPULATION, 1940

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	51.61	100,000	54.79	100,000	53.14
1- 4	90,524	55.98	90,863	59.27	90,688	57.57
5- 9	86,100	54.76	85,887	58.59	85,999	56.60
10-14	85,194	50.31	85,233	54.02	85,211	52.10
15-19	84,710	45.58	84,714	49.33	84,711	47.39
20-24	83,938	40.98	83,480	45.02	83,703	42.93
25-29	81,447	37.16	80,702	41.49	81,059	39.25
30-34	79,651	32.94	78,443	37.61	79,041	35.19
35-39	76,861	29.04	74,654	34.39	75,761	31.61
40-44	72,648	25.58	70,902	31.08	71,775	28.22
45-49	66,438	22.74	67,510	27.52	66,889	25.10
50-54	60,643	19.68	64,820	23.55	62,636	21.64
55-59	53,062	17.13	61,993	19.51	57,296	18.42
60-64	48,308	13.57	57,210	15.94	52,546	14.86
65-69	40,842	10.59	50,730	12.65	45,590	11.74
70-74	30,807	8.23	44,719	9.02	37,717	8.67
75+	21,376	5.76	32,115	6.57	26,722	6.21

TABLE IV.3
SELECTED LIFE TABLE VALUES

(d) AGGREGATE POPULATION, 1950

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	65.35	100,000	66.96	100,000	66.64
1- 4	94,204	68.35	95,548	69.07	94,846	69.25
5- 9	92,523	65.56	94,291	65.96	93,371	66.31
10-14	91,985	60.93	93,929	61.21	92,918	61.62
15-19	91,769	56.06	93,291	56.61	92,502	56.89
20-24	91,386	51.29	92,019	52.36	91,923	52.23
25-29	90,849	46.58	90,639	48.12	91,252	47.60
30-34	90,186	41.90	89,903	43.49	90,565	42.94
35-39	89,323	37.28	88,184	39.29	89,437	38.45
40-44	87,769	32.90	86,116	35.17	87,721	34.15
45-49	85,901	28.56	83,607	31.15	85,628	29.93
50-54	81,849	24.85	79,533	27.62	81,547	26.30
55-59	77,495	21.10	75,264	24.05	77,195	22.64
60-64	73,070	17.23	70,810	20.40	72,722	18.88
65-69	63,252	14.52	63,356	17.51	63,995	16.11
70-74	52,220	12.06	55,006	14.79	54,307	13.54
75+	39,483	10.14	44,005	12.86	42,450	11.63

(e) AGGREGATE POPULATION, 1960

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	67.57	100,000	72.03	100,000	69.45
1- 4	97,130	68.56	97,684	72.74	97,394	70.30
5- 9	96,607	64.92	97,218	69.07	96,899	66.65
10-14	96,326	60.10	96,900	64.29	96,600	61.85
15-19	96,022	55.29	96,629	59.47	96,311	57.02
20-24	95,187	50.75	96,463	54.56	95,735	52.35
25-29	94,107	46.30	96,101	49.76	94,887	47.80
30-34	93,506	41.58	95,517	45.05	94,293	43.08
35-39	92,513	37.00	95,289	40.15	93,536	38.41
40-44	91,843	32.25	94,365	35.52	92,782	33.70
45-49	90,029	27.85	92,593	31.15	90,982	29.32
50-54	86,792	23.80	90,181	26.92	88,034	25.22
55-59	81,643	20.14	86,191	23.05	83,344	21.50
60-64	73,968	16.97	82,993	18.84	77,617	17.90
65-69	63,947	14.24	76,121	15.32	69,003	14.82
70-74	51,442	12.10	67,663	11.92	58,551	12.02
75-79	40,330	9.74	50,412	10.14	44,595	10.00
79-84	19,180	12.72	37,552	7.76	28,251	9.34
85+	10,683	15.86	21,225	6.80	15,857	9.68

TABLE IV.3
SELECTED LIFETABLE VALUES

(f) AGGREGATE POPULATION, 1970

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	64.38	100,000	72.62	100,000	67.86
1- 4	97,373	65.11	98,434	72.77	97,882	68.32
5- 9	96,739	61.53	97,900	69.16	97,297	64.72
10-14	96,527	56.66	97,729	64.27	97,104	59.84
15-19	96,107	51.89	97,499	59.42	96,775	55.04
20-24	94,234	47.87	97,166	54.61	95,640	50.66
25-29	92,989	43.48	96,721	49.85	94,667	46.16
30-34	91,909	38.96	96,380	45.02	93,906	41.51
35-39	90,748	34.43	96,076	40.16	93,098	36.85
40-44	89,461	29.89	95,425	35.41	92,055	32.24
45-49	86,945	25.68	94,433	30.76	90,060	27.90
50-54	84,404	21.38	91,651	26.62	87,420	23.67
55-59	79,689	17.50	89,168	22.29	83,587	19.64
60-64	71,851	14.13	83,476	18.64	76,563	16.21
65-69	59,345	11.58	76,448	15.12	66,325	13.32
70-74	48,525	8.61	66,953	11.91	56,244	10.26
75-79	30,767	7.13	51,455	9.75	39,628	8.52
79-84	19,180	4.57	40,645	6.67	28,943	5.74
85+	10,683	5.67	21,683	5.32	11,804	5.45

(g) AGGREGATE POPULATION, 1980

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	69.29	100,000	75.39	100,000	72.11
1- 4	98,731	69.18	98,519	75.52	98,627	72.11
5- 9	98,453	65.37	98,307	71.68	98,381	68.29
10-14	98,276	60.48	98,148	66.79	98,213	63.40
15-19	98,107	55.58	98,088	61.83	98,097	58.47
20-24	97,466	50.93	97,739	57.04	97,593	53.76
25-29	96,420	46.45	97,420	52.22	96,878	49.14
30-34	95,404	41.92	96,946	47.47	96,130	44.50
35-39	94,297	37.38	96,691	42.58	95,426	39.81
40-44	93,465	32.70	95,906	37.91	94,614	35.13
45-49	91,660	28.29	95,176	33.18	93,312	30.59
50-54	88,344	24.26	94,315	28.46	91,147	26.25
55-59	83,668	20.47	91,651	24.22	87,301	22.30
60-64	77,980	16.79	87,681	20.20	82,305	18.50
65-69	68,191	13.84	81,988	16.43	74,313	15.22
70-74	57,027	11.05	71,935	13.38	63,614	12.36
75-79	46,068	8.09	59,343	10.69	51,948	9.58
79-84	29,688	6.17	46,055	8.05	37,414	7.33
85+	17,535	3.72	27,897	6.66	22,448	5.55

TABLE IV.4
SELECTED LIFETABLE VALUES

(a) CHAMORRO POPULATION, 1930

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	40.22	100,000	42.30	100,000	41.18
1- 4	84,351	46.63	85,714	48.30	85,010	47.39
5- 9	68,556	52.91	69,715	54.93	69,122	53.83
10-14	66,767	49.26	67,867	51.36	67,304	50.21
15-19	66,215	44.65	66,950	47.03	66,573	45.74
20-24	64,810	40.57	65,319	43.14	65,059	41.74
25-29	62,388	37.04	62,008	40.31	62,191	38.55
30-34	60,681	33.02	58,081	37.87	59,328	35.29
35-44	58,715	29.04	55,981	34.19	57,295	31.46
45-54	51,807	22.24	50,138	27.59	50,930	24.76
55-64	42,196	16.17	41,521	22.28	41,859	19.05
65-74	30,753	10.33	33,200	16.61	32,188	13.26
75+	15,455	5.60	19,920	14.36	17,942	9.83

(b) CHAMORRO POPULATION, 1940

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	49.77	100,000	54.02	100,000	51.81
1- 4	90,659	53.87	91,079	58.28	90,862	55.99
5- 9	85,939	52.72	85,705	57.81	85,830	55.15
10-14	84,956	48.30	85,000	53.27	84,978	50.68
15-19	84,436	43.58	84,437	48.61	84,437	45.99
20-24	83,591	38.99	83,125	44.34	83,351	41.56
25-29	80,334	35.47	80,272	40.82	80,325	38.03
30-34	78,192	31.38	77,803	37.04	78,018	34.08
35-39	74,910	27.64	73,643	33.99	74,288	30.66
40-44	70,086	24.37	69,596	30.82	69,856	27.45
45-49	63,296	21.72	66,121	27.31	64,672	24.45
50-54	57,242	18.75	63,619	23.29	60,387	21.01
55-59	49,346	16.35	60,741	19.27	54,612	17.96
60-64	44,251	12.95	55,899	15.73	49,699	14.49
65-69	36,830	10.05	49,722	12.37	42,959	11.38
70-74	27,098	7.76	43,630	8.75	35,236	8.32
75+	18,164	5.35	30,903	6.32	24,437	5.89

TABLE IV.4
SELECTED LIFETABLE VALUES

(c) CHAMORRO POPULATION, 1950

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	59.83	100,000	64.91	100,000	62.42
1- 4	93,953	62.67	95,346	67.07	94,619	64.96
5- 9	91,735	60.13	93,624	64.27	92,644	62.30
10-14	91,039	55.57	93,156	59.58	92,103	57.65
15-19	90,959	50.62	92,441	55.02	91,722	52.88
20-24	90,193	46.03	91,029	50.83	90,652	48.47
25-29	88,995	41.62	89,284	46.78	89,171	44.24
30-34	87,870	37.12	88,227	42.31	88,083	39.75
35-39	85,928	32.90	85,857	38.41	85,901	35.70
40-44	82,748	29.07	83,210	34.55	82,993	31.86
45-49	78,671	25.44	79,852	30.90	79,288	28.24
50-54	71,504	22.74	75,356	27.59	73,483	25.27
55-59	65,423	19.62	71,410	23.98	68,516	21.92
60-64	59,962	16.18	66,862	20.44	63,491	18.46
65-69	50,266	13.82	59,824	17.55	55,188	15.86
70-74	41,230	11.31	51,698	14.91	46,648	13.30
75+	29,898	9.64	41,718	12.88	36,199	11.42

(d) CHAMORRO POPULATION, 1960

AGE GROUP	MALES l(x)	MALES e(x)	FEMALES l(x)	FEMALES e(x)	BOTH SEXES l(x)	BOTH SEXES e(x)
< 1	100,000	62.84	100,000	70.36	100,000	66.64
1- 4	96,625	64.03	97,205	71.38	96,901	67.76
5- 9	95,958	60.46	96,491	67.89	96,211	64.23
10-14	95,747	55.59	96,068	63.18	95,894	59.44
15-19	95,336	50.82	95,764	58.37	95,536	54.65
20-24	94,630	46.18	95,660	53.43	95,126	49.87
25-29	93,401	41.75	95,302	48.62	94,388	45.24
30-34	91,799	37.44	94,864	43.84	93,426	40.69
35-39	90,179	33.06	94,707	38.91	92,549	36.05
40-44	89,328	28.35	92,846	34.64	91,160	31.56
45-49	85,627	24.47	90,226	30.57	88,058	27.58
50-54	78,813	21.37	87,932	26.30	83,610	23.92
55-59	71,568	18.28	83,717	22.50	77,880	20.49
60-64	62,274	15.64	80,330	18.34	71,474	17.10
65-69	52,154	13.19	73,405	14.84	62,788	14.12
70-74	41,057	11.08	64,769	11.48	52,694	11.35
75-79	32,703	8.27	47,472	9.76	39,978	9.17
79-84	15,287	9.83	34,979	7.35	25,148	8.10
85+	8,970	10.00	18,634	6.60	13,981	7.57

TABLE IV.5
LIFE EXPECTANCY AT BIRTH, GUAM 1920-1980.

YEAR	AGGREGATE MALES	AGGREGATE FEMALES	AGGREGATE BOTH	CHAMORRO MALES	CHAMORRO FEMALES	CHAMORRO BOTH
1920	30.94	31.14	30.99	*	*	*
1930	42.70	43.36	43.10	40.22	42.30	41.18
1940	51.61	54.79	53.14	49.77	54.02	51.81
1950	65.37	66.96	66.66	59.90	64.91	62.46
1960	67.57	72.03	69.45	62.84	70.36	66.64
1970	64.38	72.62	67.86	*	*	*
1980	69.29	75.39	72.11	*	*	67.63

Note:
* not available

FIGURE IV.4 (a)

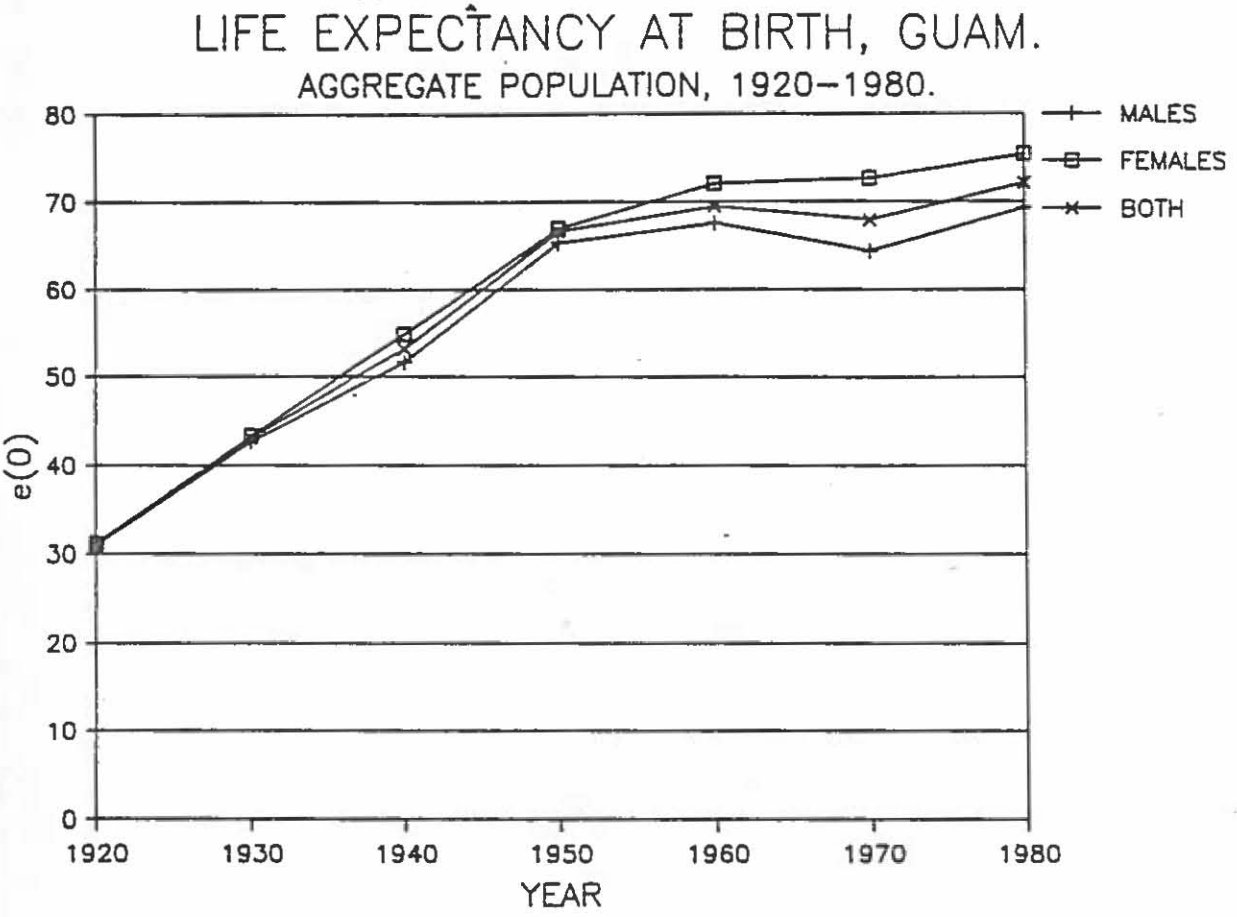
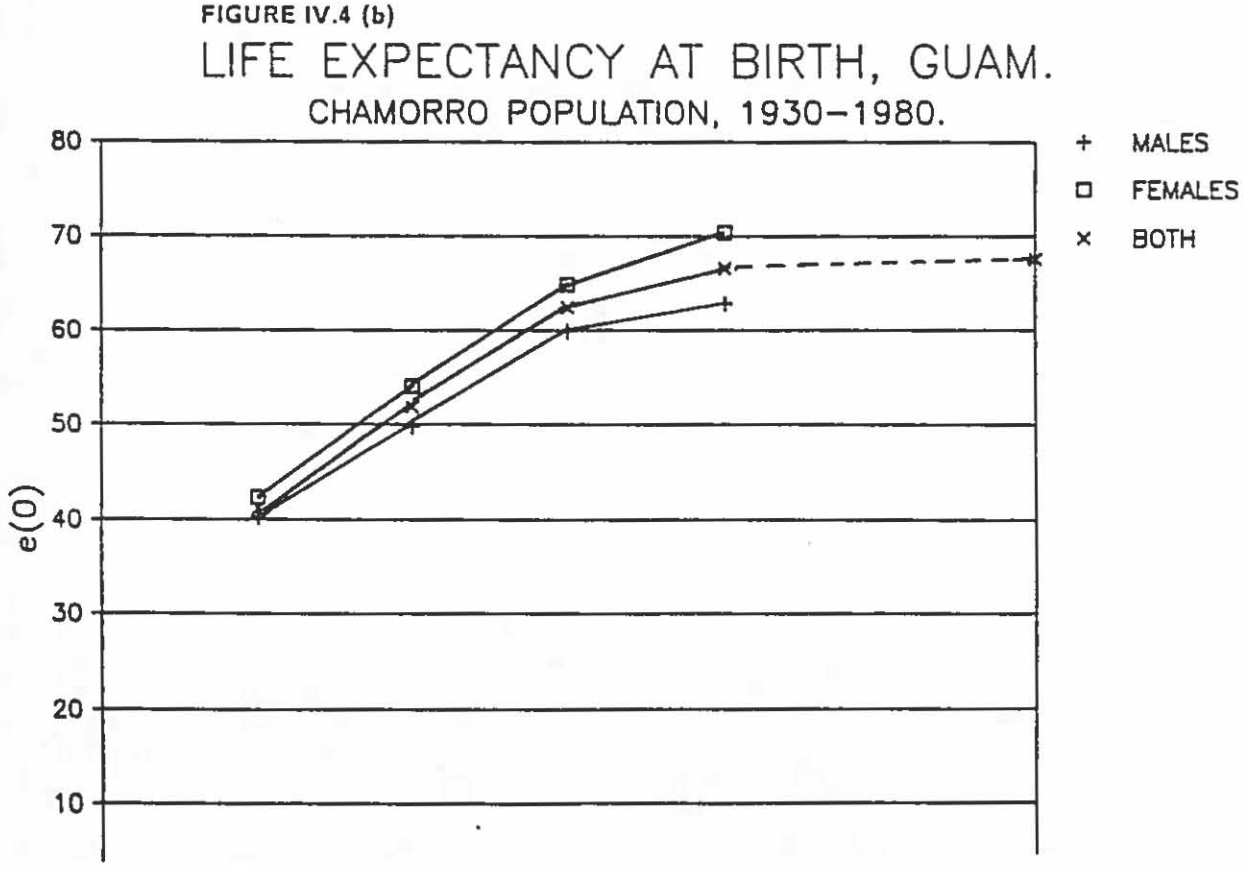


FIGURE IV.4 (b)



reflect the high mortality level that prevailed during most of the decade 1940-1950. As for the 1935 values, those for Chamorro females appear to be much in agreement with the surrounding values. Chamorro males do not show such close agreement, although interpolation between 1930 and 1940 would result in a value only just above the plotted median.

Conclusion.

As indicated by all employed measures in this chapter, a decline in mortality among Guam's population has set in during the first two decades of this century. Although several events have taken place that obscure this trend, it is clearly indicated in the development in Infant Mortality Rates. These have dropped from an average level of about 150 per thousand live births to about 11 over the period under consideration. The decline in mortality is also reflected in the values for life expectancy at birth, which has risen from 42.7 and 43.4 years for males and females in 1930, to 69.3 and 75.4 in 1980 for males and females, respectively.

The Chamorro population on Guam appears to be the main contributor in this development, although all measures indicate that the Chamorros experience a slightly higher level of mortality than the other ethnic groups. This shows itself in the increasing discrepancy in life expectancy values between the Chamorro and aggregate population, especially for males.

It may further be noted that the difference between life expectancy at birth for males and females tends to increase. This may indicate that the decline in mortality has come to an end, at least as far as the male population is concerned.

FIGURE IV.5 (a)

LIFE EXPECTANCY AT BIRTH, GUAM 1930–1960.

CHAMORRO MALES, ACTUAL & MODEL LIFE TABLES.

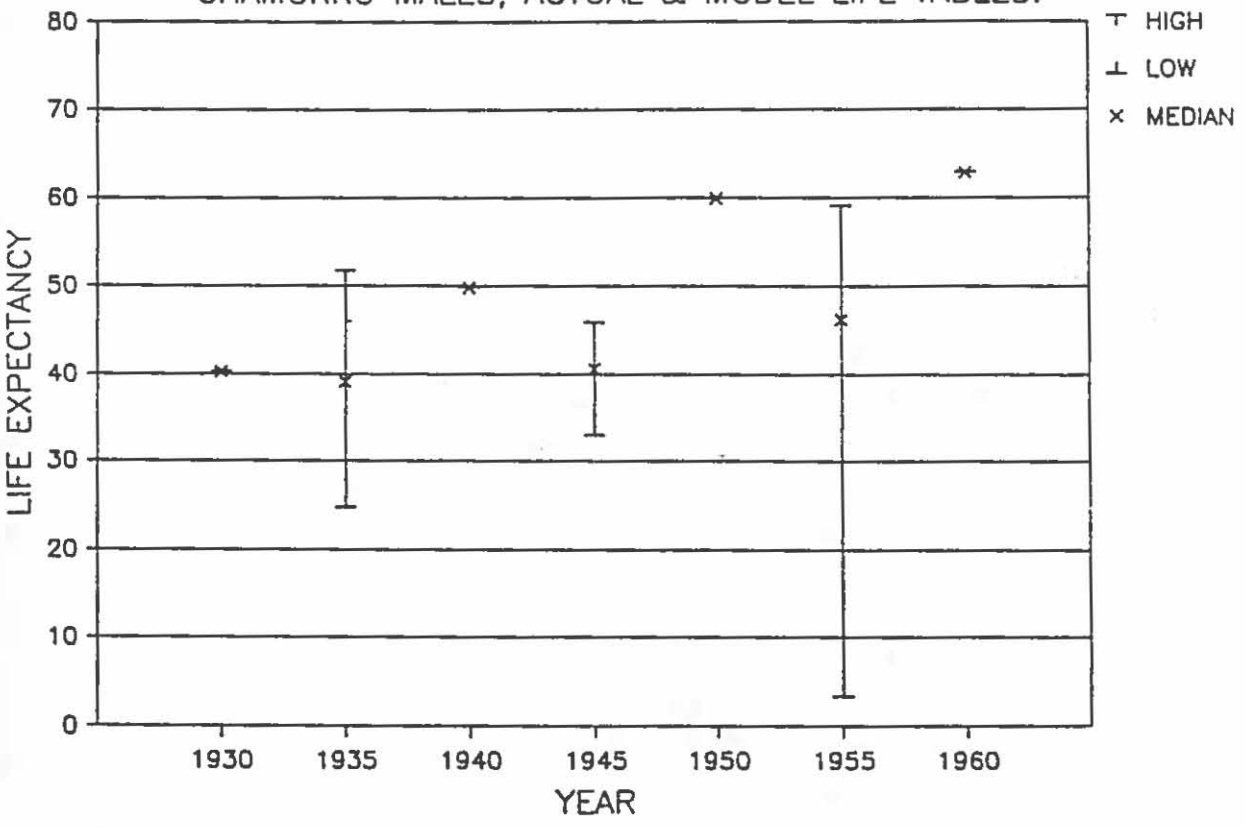
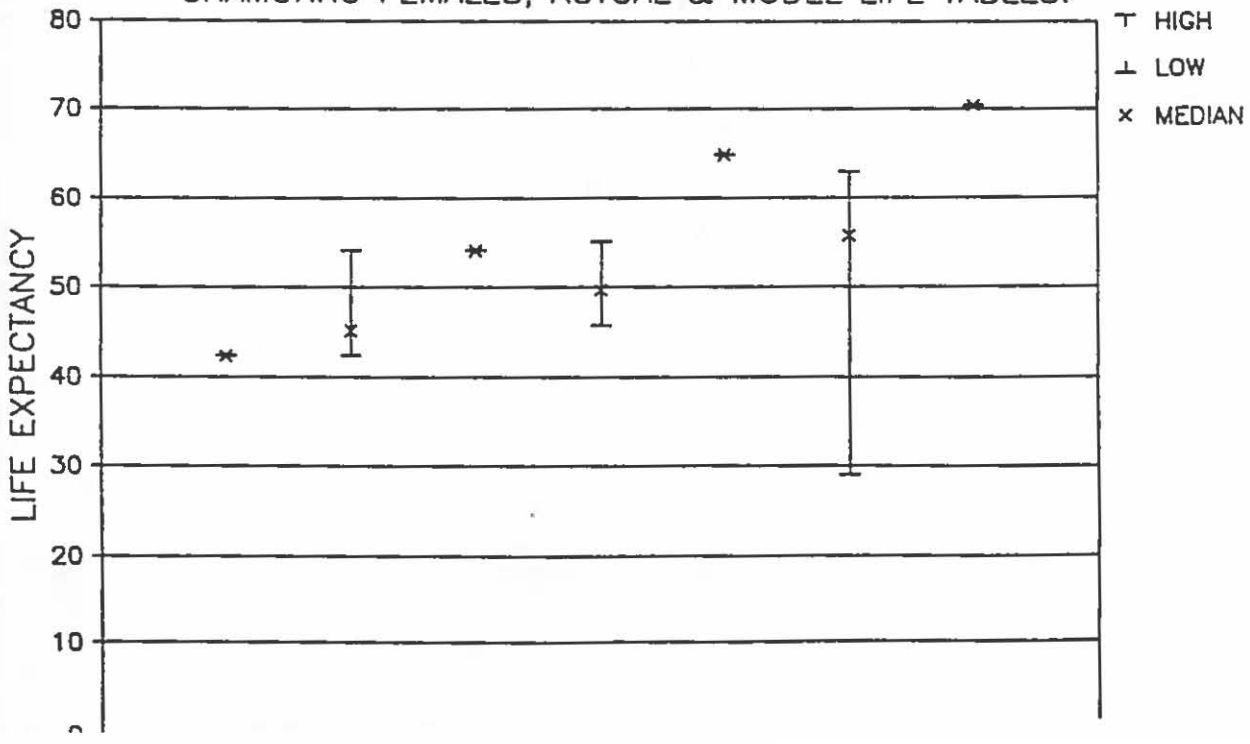


FIGURE IV.5 (b)

LIFE EXPECTANCY AT BIRTH, GUAM 1930–1960.

CHAMORRO FEMALES, ACTUAL & MODEL LIFE TABLES.



The patterns of the development in both fertility and mortality parameters for the Chamorro population indicate the timing and intensity of the process called "Demographic Transition". This process depicts the change in demographic characteristics according to four phases:

phase 1 - high birth and death rates,

phase 2 - high birth rates and declining death rates,

phase 3 - declining birth rates and low death rates,

phase 4 - low birth rates and low death rates.

From the last two chapters it can be observed that Guam's population has started the Demographic Transition around the year 1920 and finds itself presently in phase 3. The assumptions under which the population projections in chapter VI have been made reflect the consequences of this observation.

CHAPTER V - MIGRATION

Introduction.

The third major component, along with fertility and mortality, accounting for population change is migration. However, migration is conceptually different since it does not involve the beginning or termination of a human life. Yet, looking at a particular aerial unit, migration does affect the size and composition of a population. Social and economic forces tend to influence migration more directly than they influence fertility and mortality. Migration is not subject to those "biological inertia" that set the limits within which fertility and mortality regimes may be established. So far, no such concept as "migration regime" has been developed within demographic theory.

Conceptual difficulties are aggravated in the case of Guam. A distinction between "internal" and "international" migration, for example, does not add any analytic power; internal migration signifies travel within Guam in just the same way as it signifies travel between Guam and any state in the U.S. Not only are some concepts inappropriate, separate registration of migration becomes more difficult under these circumstances. Unlike the registration of births and deaths, registration of migration cannot be enforced on Guam. The basic right of free movement throughout the U.S. and its possessions and the absence of a migration registration system in the U.S. (and therefore also Guam) precludes such registration.

The description of international migration that appears to be most relevant in the present context designates it as movement to and from the island of Guam, regardless of the crossing of international boundaries. Internal migration consequently means movement within the island of Guam, most readily appreciated

when districts are considered. In the present context migrants are those who move in order to change their usual residence and cross an administrative border to do so. The concept "usual residence" is identical to the one employed in the census. In practice this means a stay extending beyond six months.

Internal Migration.

No cross-tabulation in any census report is available that allows the identification of migration streams between districts or any other aerial subdivision within Guam. The best that can be done involves the tabulation of district/municipality of enumeration for consecutive censuses. Although this allows observation of net shifts in population, no indication can be obtained as to the origin and destination of people who change residence within the island. Table V.1 presents the number and percentage of people residing in each of Guam's territorial subdivisions since 1930.

The concept of urbanization generally is closely related to patterns of internal migration, especially when developing nations are concerned. A well-known phenomenon is that with increasing economic development an increasing proportion of the population will take up residence in one or more major cities. Guam shows a completely different pattern: table V.2 indicates that at least since 1920 the concentration of the population in Guam's only major population center, Agana, started to decline. Although part of Agana was annexed to Sinajana in 1947 it is evident that after World War II Guam's population distribution had fundamentally changed. Tamuning appears to have become the major population concentration, but not nearly to the extent that Agana had been before World War II.

TABLE V.1
POPULATION DISTRIBUTION BY MUNICIPALITY & DISTRICT, GUAM 1930-1980.

MUNICIPALITY	AREA (SQM)	1930 POPN*	DENSITY	%DISTR.	1940 POPN	DENSITY	%DISTR.	1950 POPN	DENSITY	%DISTR.
AGANA	1	11,042	-	59.66%	10,004	10,004	44.88%	800	800	1.34%
AGAT	25	887	-	4.79%	1,068	43	4.79%	4,682	187	7.87%
ASAN	5	559	-	3.02%	656	131	2.94%	3,090	618	5.19%
BARRIGADA	18	-	-	-	875	49	3.93%	11,534	641	19.39%
DEDEDO	27	-	-	-	1,196	44	5.37%	6,441	239	10.83%
INARAJAN	19	1,176	-	6.35%	1,076	57	4.83%	1,490	78	2.50%
MACHANAO	20	-	-	-	275	14	1.23%	684	34	1.15%
MERIZO	7	1,101	-	5.95%	866	124	3.89%	1,086	155	1.83%
PITI	7	928	-	5.01%	1,175	168	5.27%	1,902	272	3.20%
SINAJANA	6	-	-	-	1,236	206	5.55%	9,169	1,528	15.41%
SUMAY	4	2,327	-	12.57%	1,997	499	8.96%	6,718	1,680	11.29%
TALOFOFO	14	-	-	-	456	33	2.05%	913	65	1.53%
UMATAC	7	-	-	-	430	61	1.93%	580	83	.97%
YIGO	25	-	-	-	324	13	1.45%	9,022	361	15.16%
YONA	18	489	-	2.64%	656	36	2.94%	1,387	77	2.33%
TOTAL	203	18,509	91	100.00%	22,290	110	100.00%	59,498	293	100.00%

YEAR DISTRICT	AREA (SQM)	1960 POPN	DENSITY	%DISTR.	1970 POPN	DENSITY	%DISTR.	1980 POPN	DENSITY	%DISTR.
AGANA	1	1,642	1,642	2.45%	2,119	2,119	2.49%	896	896	.85%
AGANA HEIGHTS	1	3,210	3,210	4.79%	3,156	3,156	3.71%	3,284	3,284	3.10%
AGAT	10	3,107	311	4.63%	4,308	431	5.07%	3,999	400	3.77%
ASAN	6	3,053	509	4.55%	2,629	438	3.09%	2,034	339	1.92%
BARRIGADA	9	6,918	769	10.32%	6,356	706	7.48%	7,756	862	7.32%
CHALAN PAGO/ORDOT	6	1,835	306	2.74%	2,931	489	3.45%	3,120	520	2.94%
DEDEDO	30	5,126	171	7.65%	10,780	359	12.68%	23,644	788	22.31%
INARAJAN	19	1,730	91	2.58%	1,897	100	2.23%	2,059	108	1.94%
MANGILAO	10	1,965	197	2.93%	3,228	323	3.80%	6,840	684	6.45%
MERIZO	6	1,398	233	2.09%	1,529	255	1.80%	1,663	277	1.57%
MONGMONG/TOTO/MAITE	2	3,015	1,508	4.50%	6,057	3,029	7.13%	5,245	2,623	4.95%
PITI	7	1,467	210	2.19%	1,284	183	1.51%	2,866	409	2.70%
SANTA RITA	17	10,638	626	15.87%	8,109	477	9.54%	9,183	540	8.66%
SINAJANA	1	3,862	3,862	5.76%	3,506	3,506	4.12%	2,485	2,485	2.34%
TALOFOFO	17	1,352	80	2.02%	1,935	114	2.28%	2,006	118	1.89%
TAMUNING	6	5,944	991	8.87%	10,218	1,703	12.02%	13,580	2,263	12.81%
UMATAC	6	744	124	1.11%	813	136	.96%	732	122	.69%
YIGO	35	7,682	219	11.46%	11,542	330	13.58%	10,359	296	9.77%
YONA	20	2,356	118	3.51%	2,599	130	3.06%	4,228	211	3.99%
TOTAL	209	67,044	321	100.00%	84,996	407	100.00%	105,979	507	100.00%

Note:
* Sumay includes 1,118 U.S. Navy personnel.

TABLE V.2
POPULATION IN URBAN PLACES (>2,500), GUAM 1920-1980.

PLACE	1920 POPN	PERCENT	1930 POPN	PERCENT	1940 POPN	PERCENT
AGANA	7,432	54.67%	8,690	46.95%	10,004	44.88%

PLACE	1950 POPN	PERCENT	1960 POPN	PERCENT	1970 POPN	PERCENT	1980 POPN	PERCENT
AGANA HEIGHTS	*	*	3,210	4.79%	3,156	3.71%	2,970	2.80%
AGAT	*	*	2,596	3.87%	2,612	3.07%	2,908	2.74%
ANDERSON AFB #	*	*	*	*	*	*	4,892	4.62%
APRA HARBOR #	*	*	*	*	*	*	5,633	5.32%
BARRIGADA	*	*	*	*	*	*	3,127	2.95%
DEDEDO	*	*	*	*	*	*	2,524	2.38%
FINEGAYAN ST. #	*	*	*	*	*	*	3,538	3.34%
MANGILAO	*	*	*	*	*	*	4,029	3.80%
MONGMONG	*	*	*	*	5,052	5.94%	*	*
SINAJANA	3,069	5.16%	2,861	4.27%	2,621	3.08%	*	*
TAMUNING	*	*	5,380	8.02%	8,230	9.68%	8,862	8.36%
YIGO	*	*	*	*	*	*	3,392	3.20%
TOTAL	3,069	5.16%	14,047	20.95%	21,671	25.50%	41,875	39.51%

Notes:
military population centers, not separately tabulated prior to 1980.
* <2,500

Net Migration by Ethnicity.

The foregoing does not mean that at present no useful or trustworthy information on migration is available. The fact that out of the three components that altogether make up the total change in Guam's population two are registered means that the third component can be estimated as the residual. This also means, however, that using this methodology the various migration streams cannot be separately identified. Only the total gain or loss in population over a certain period of time through Net Migration can be estimated. The subdivision of Guam's aggregate population into various ethnic groups fortunately does yield considerable additional insight, as will be shown below.

The method presently employed is called the Intercensal Component Method. Net Migration is estimated in this method as the part of the total change in population that cannot be accounted for by the registered number of births and deaths during the period between two successive census counts.

From table V.3 and figure V.1 it can be noted that the net migration before World War II was relatively insignificant. As in earlier chapters information for this period is presented only for the aggregate population. After 1945 a subdivision of migrants according to ethnicity becomes important: it allows the identification of migration streams of different size. It can be observed that all non-Chamorro population groups on Guam increased dramatically through net inmigration between 1940 and 1950. Considering that this effectively took place between 1945 and 1950, it seems an understatement to typify this as a migration wave. Historical records show that the inmigration of Caucasians is related to Guam's recognition as a strategic military base. The net inmigration of almost 7,000 Filipinos was closely related to the rebuilding of war-devastated Guam. Overall, the population of Guam gained almost 30,000 people through this migration wave.

TABLE V.3
NET MIGRATION, GUAM 1901-1980.
INTERCENSAL COMPONENT METHOD.

AGGREGATE POPULATION.

PERIOD	P(1)	P(0)	BIRTHS	DEATHS	NET MIGRATION	% of NAT. INCREASE
1901-10	11,806	9,676	4,556	2,480	54	2.60%
1910-20	13,595	11,806	5,926	3,589	-548	(23.45%)
1920-30	18,509	13,595	7,558	3,580	936	23.53%
1930-40	22,290	18,509	9,162	4,566	-815	(17.73%)
1940-50	59,498	22,290	11,809	4,064	29,463	380.41%
1950-60	67,044	59,498	21,617	2,800	-11,271	(59.90%)
1960-70	84,996	67,044	25,466	3,335	-4,179	(18.88%)
1970-80	105,979	84,996	30,680	4,100	-5,597	(21.06%)

CHAMORRO POPULATION.

PERIOD	P(1)	P(0)	BIRTHS	DEATHS	NET MIGRATION	% of NAT. INCREASE
1940-50	27,124	20,177	10,925	3,857	-121	(1.71%)
1950-60	34,762	27,124	15,387	2,059	-5,690	(42.69%)
1960-70	42,532	34,762	16,049	2,383	-5,896	(43.14%)
1970-80	47,845	42,532	14,544	2,525	-6,706	(55.79%)

CAUCASIAN POPULATION.

PERIOD	P(1)	P(0)	BIRTHS	DEATHS	NET MIGRATION	% of NAT. INCREASE
1940-50	22,920	785	635	108	21,608	4,100%
1950-60	20,724	22,920	4,946	531	-6,611	(149.7%)
1960-70	24,882	20,724	5,422	547	-717	(14.71%)
1970-80	25,987	24,882	6,516	578	-4,833	(81.39%)

FILIPINO POPULATION.

PERIOD	P(1)	P(0)	BIRTHS	DEATHS	NET MIGRATION	% of NAT. INCREASE
1940-50	7,258	569	72	34	6,651	17,503%
1950-60	8,580	7,258	436	139	1,025	345.12%
1960-70	12,190	8,580	1,875	192	1,927	114.50%
1970-80	22,447	12,190	5,840	484	4,901	91.50%

"OTHER" POPULATION.

PERIOD	P(1)	P(0)	BIRTHS	DEATHS	NET MIGRATION	% of NAT. INCREASE
1940-50	2,196	759	112	55	1,380	2,421%
1950-60	2,978	2,196	1,028	64	-182	(18.88%)
1960-70	5,392	2,978	2,113	212	513	26.99%
1970-80	9,700	5,392	3,737	471	1,042	31.90%

FIGURE V.1 (a)

NET MIGRATION, GUAM.

AGGREGATE POPULATION, 1901–1980.

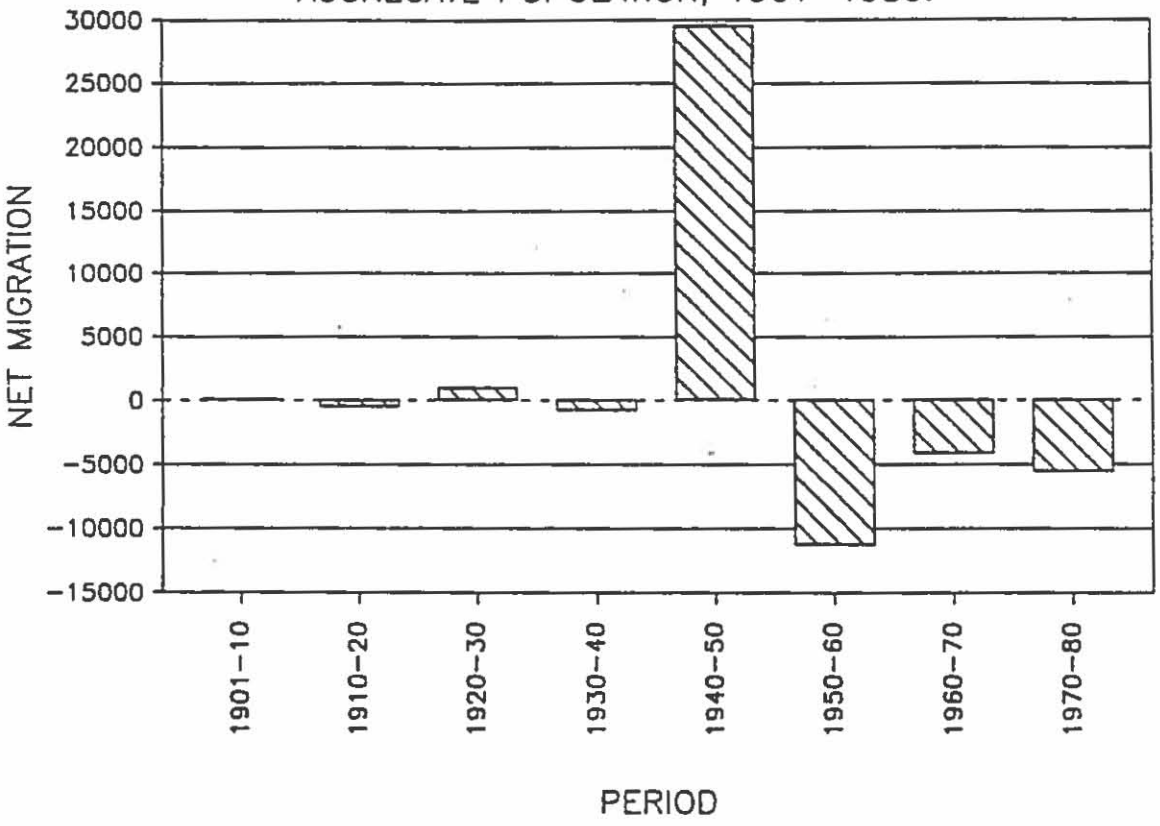
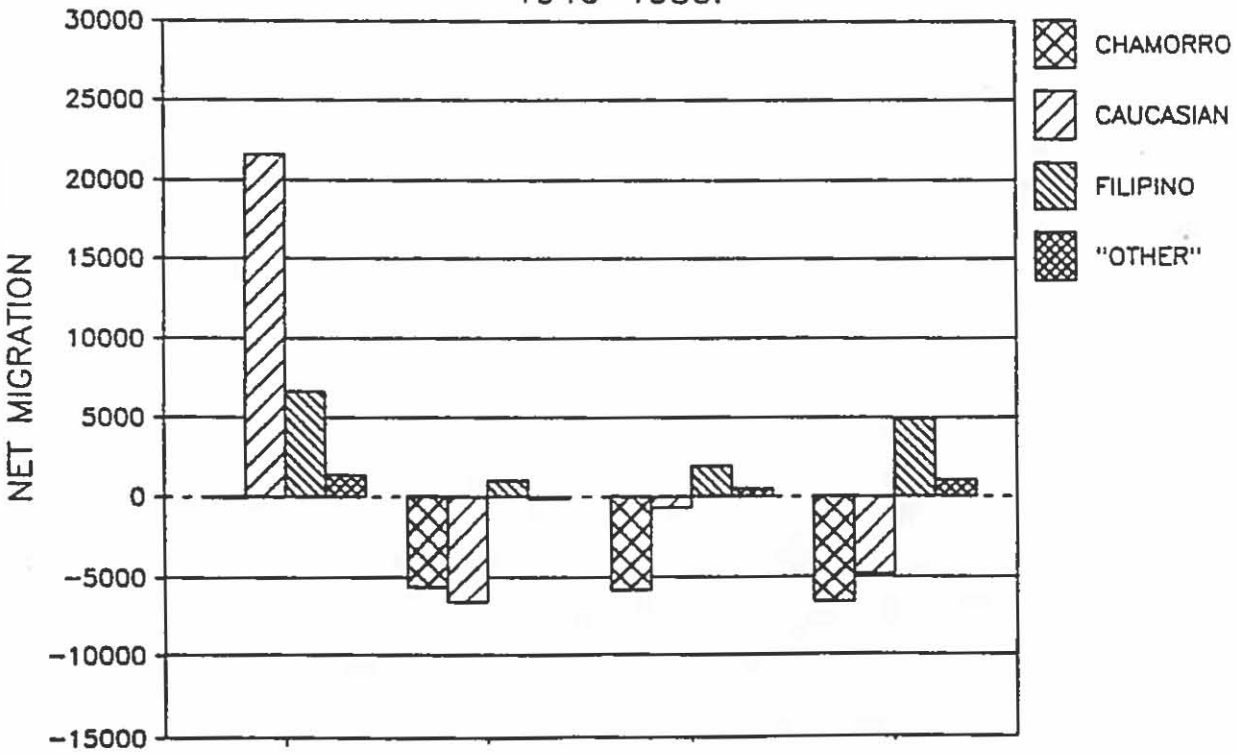


FIGURE V.1 (b)

NET MIGRATION BY ETHNICITY, GUAM.

1940–1980.



Subsequent decades show an increasing disparity between the identified migration streams. The Chamorro population experiences substantial and increasing net outmigration at a magnitude of about 6,000 per decade. The Caucasian population also loses through migration, but this appears to be of a different nature. Fluctuations in the number of military personnel and their dependents is a major contributing factor in this development. The Filipino and "Other" population groups show almost continuous net inmigration. During the decade 1970-1980 the number of inmigrants has reached a level that approaches the situation between 1945 and 1950. It seems not inappropriate therefore to refer to this period as a second wave of migration. The figures for the aggregate population, however, indicate that the inmigration is not (yet) strong enough to offset the ongoing and increasing net outmigration of Caucasians and especially Chamorros.

Net Migration by Age and Sex.

Migration is known to vary considerably with age and between sexes. As the paragraph on population composition in chapter I pointed out, migrants typically fall within the age range of 15 to 45, and are mainly males. Although this conjecture may vary considerably with the purpose of migration, it generally seems to hold in the context of Guam, as table V.4 illustrates. The data in this table result from the intercensal cohort component method. Again two successive censuses are used, but this time tabulated by age and sex. Instead of counting the absolute number of deaths during the decade between the censuses, survival rates from life tables for both censuses are used to simulate the mortality pattern. The actual number of births during the period is used to construct the two youngest cohorts, i.e. those who are 0-4 and 5-9 years of age at the time of the second census, respectively. Using this information, the development of the

TABLE V.4
NET MIGRATION, GUAM 1940-1980.
INTERCENSAL COHORT COMPONENT METHOD.
MALES

AGE GROUP	AGGREGATE 1940-50	1950-60	1960-70	1970-80	CHAMORRO 1940-50	1950-60
0- 4	258	-169	-865	-985	-428	-285
5- 9	180	-423	-184	-1,454	-307	-920
10-14	257	-141	-199	264	166	-85
15-19	3,891	789	-392	-142	4	-167
20-24	8,248	2,439	3,072	774	-205	-844
25-29	4,230	-2,128	595	1,159	-173	-680
30-34	3,010	-4,972	-904	-1,655	33	-153
35-39	2,044	-1,705	-47	-101	-29	-54
40-44	1,210	-1,557	-1,380	-797	1	-44
45-49	868	-1,058	-1,119	-971	1	-59
50-54	383	-706	-708	-609	-50	-13
55-59	154	-621	-502	-839	-8	-3
60-64	-3	-326	-292	-102	-36	-5
65-69	-16	-163	-169	-30	-7	-19
70-74	-53	-57	-94	18	-48	-17
75+	-82	-88	-6	-27	-64	-28
ALL AGES	24,579	-10,889	-3,194	-4,995	-1,148	-3,375

FEMALES

AGE GROUP	AGGREGATE 1940-50	1950-60	1960-70	1970-80	CHAMORRO 1940-50	1950-60
0- 4	173	-330	-556	-848	-396	-358
5- 9	117	-232	-305	-1,352	-315	-692
10-14	219	-59	-227	-139	152	-70
15-19	77	-205	-648	-542	21	-110
20-24	447	293	80	178	-8	-371
25-29	973	639	915	1,264	-38	-298
30-34	718	359	436	838	-1	-175
35-39	435	-290	41	48	-2	-111
40-44	255	-360	-304	-200	24	-60
45-49	101	-192	-323	-142	5	1
50-54	20	-142	-201	57	-13	-15
55-59	-42	-51	-150	27	-47	1
60-64	-18	-49	-140	49	-23	-33
65-69	-32	-19	-87	76	-30	-12
70-74	-61	-28	-61	51	-57	-23
75+	-150	-150	-98	-3	-141	-148
ALL AGES	3,231	-816	-1,630	-636	-870	-2,473

FIGURE V.2 (a)

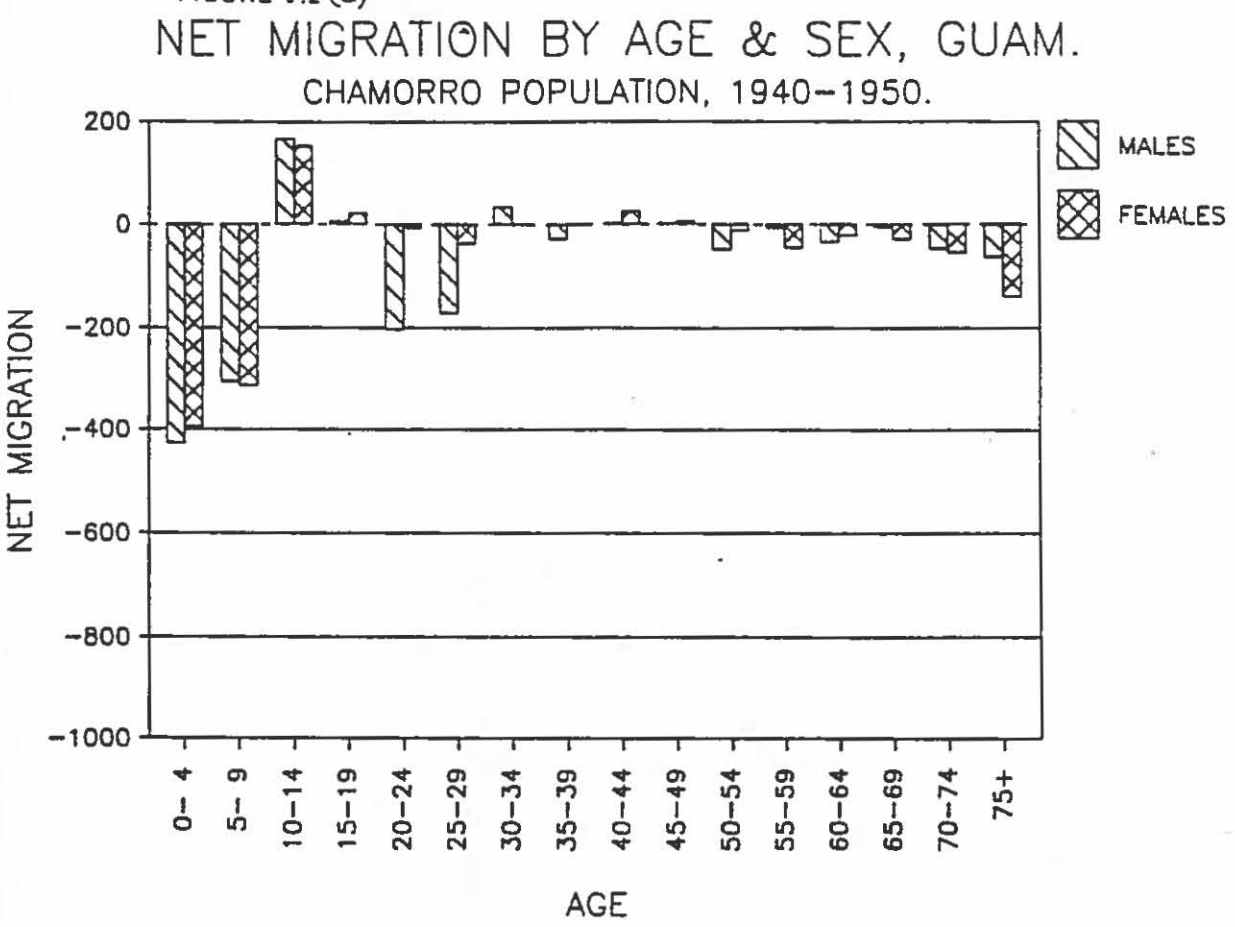


FIGURE V.2 (b)

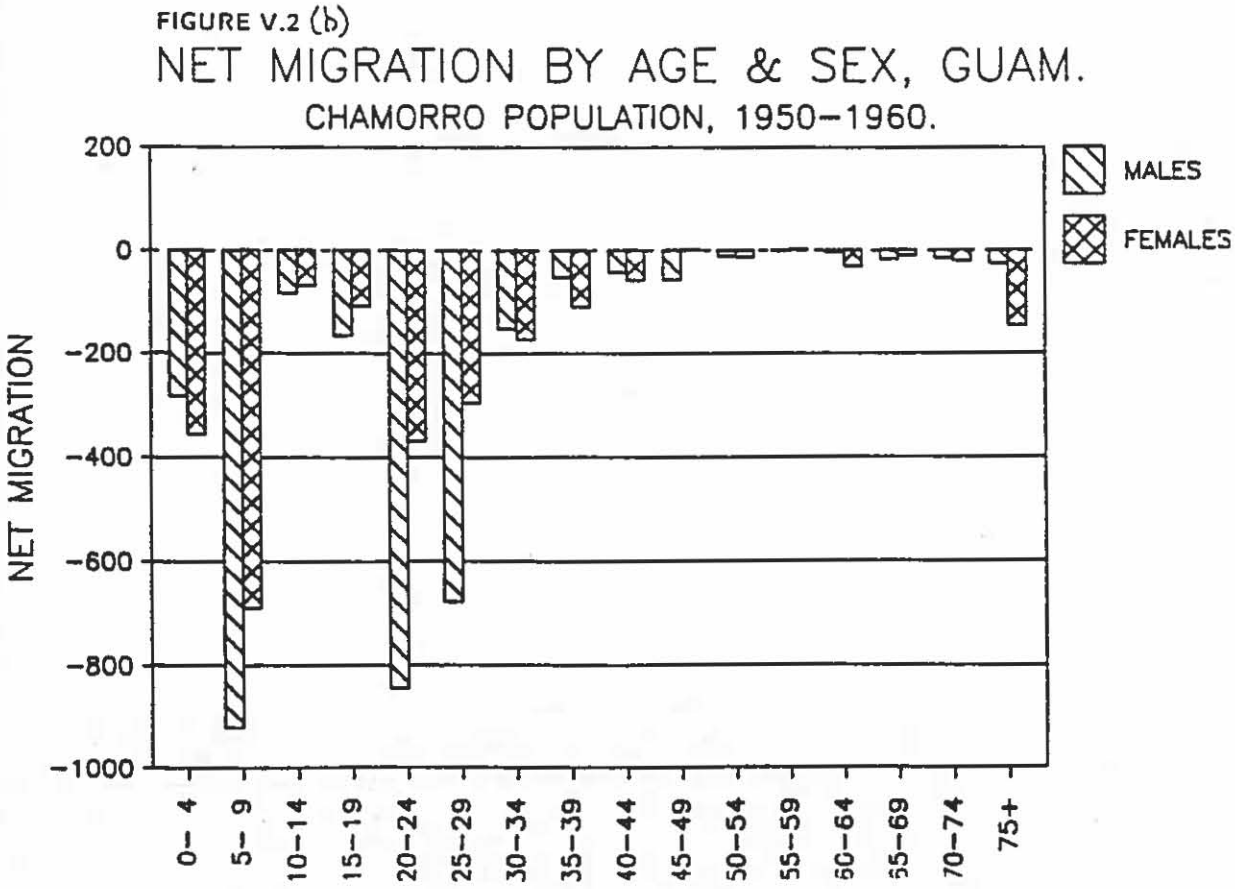


FIGURE V.3 (a)

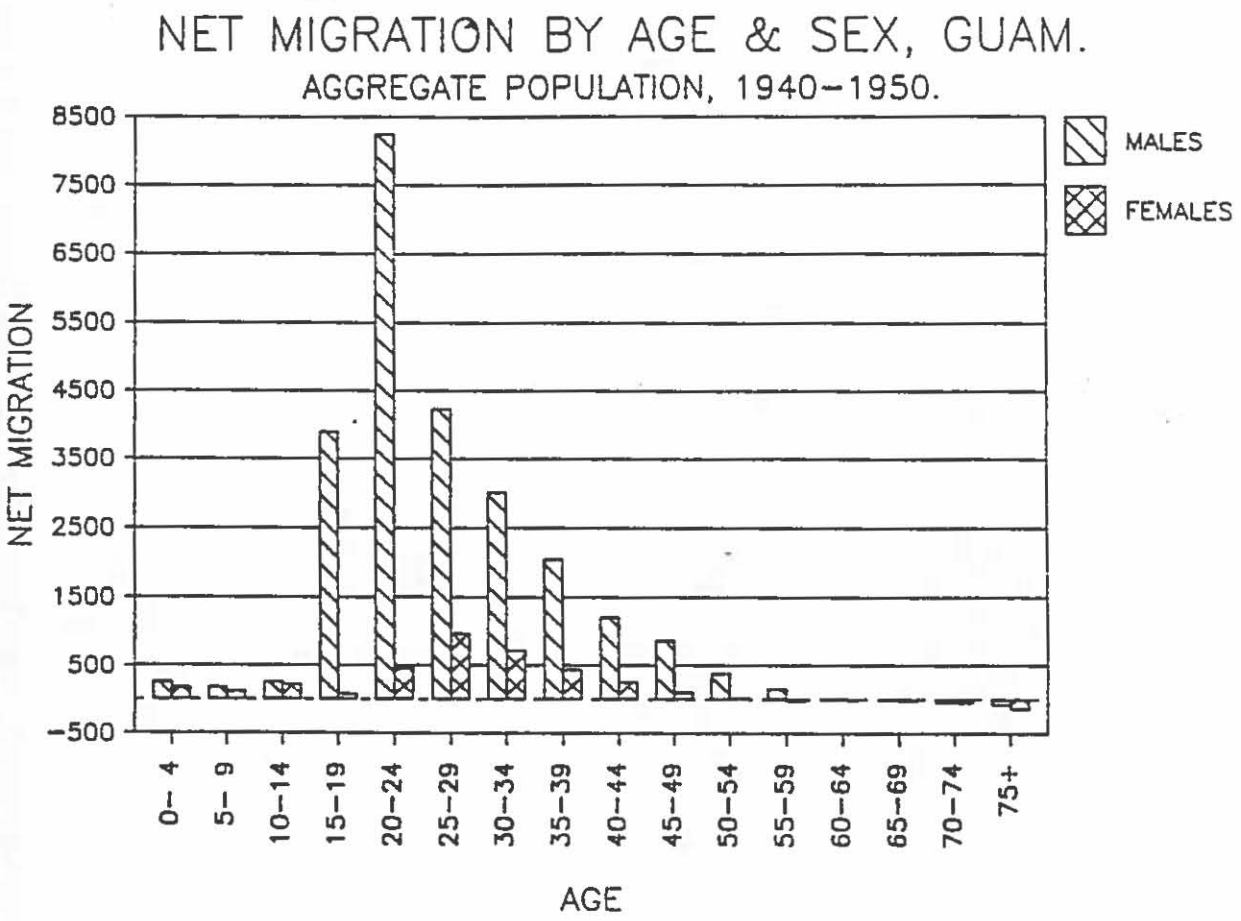


FIGURE V.3 (b)

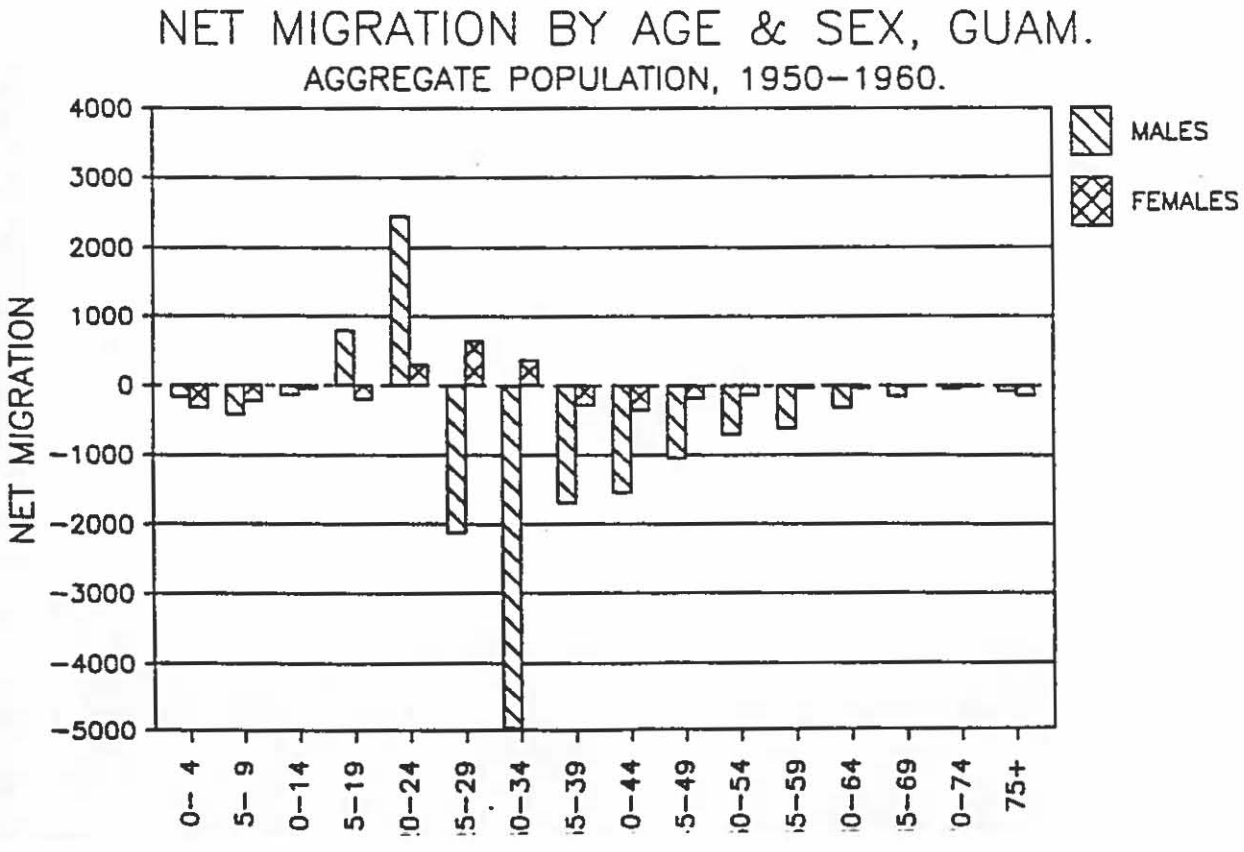


FIGURE V.3 (c)

NET MIGRATION BY AGE & SEX, GUAM.

AGGREGATE POPULATION, 1960–1970.

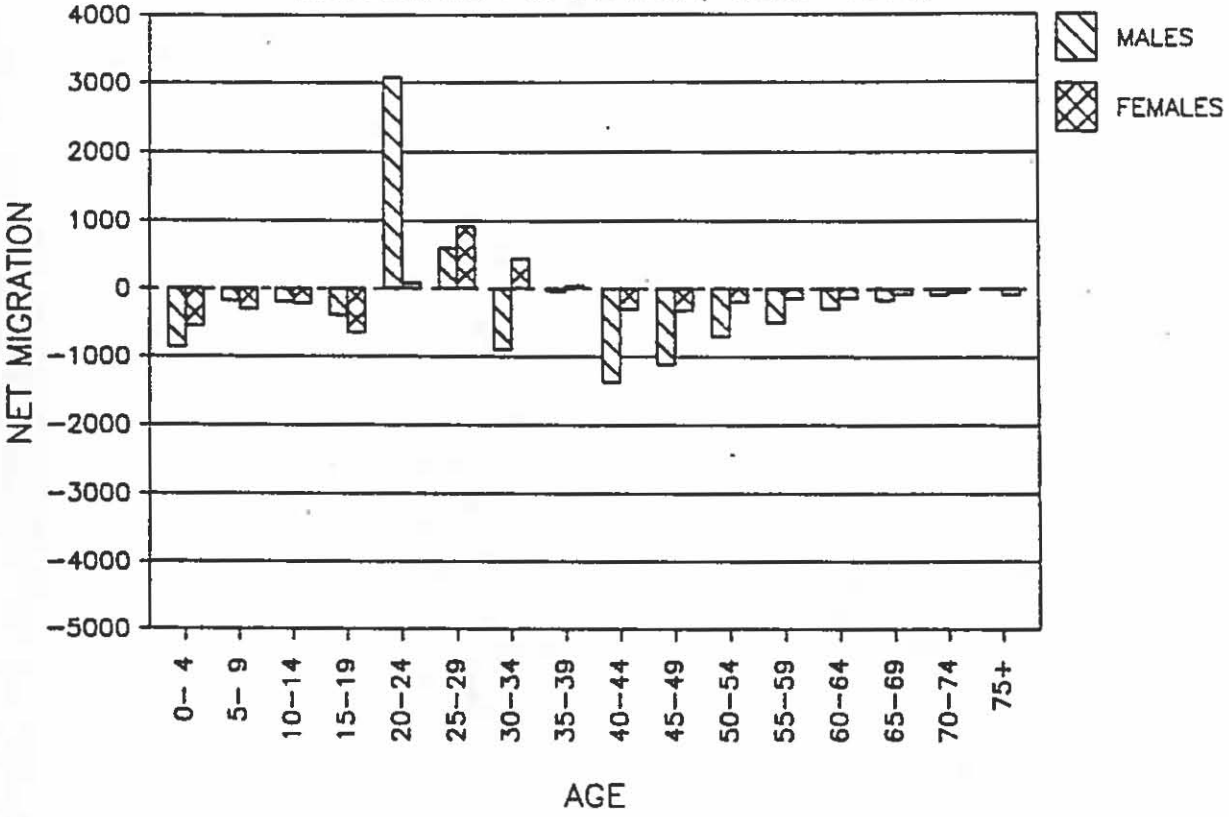
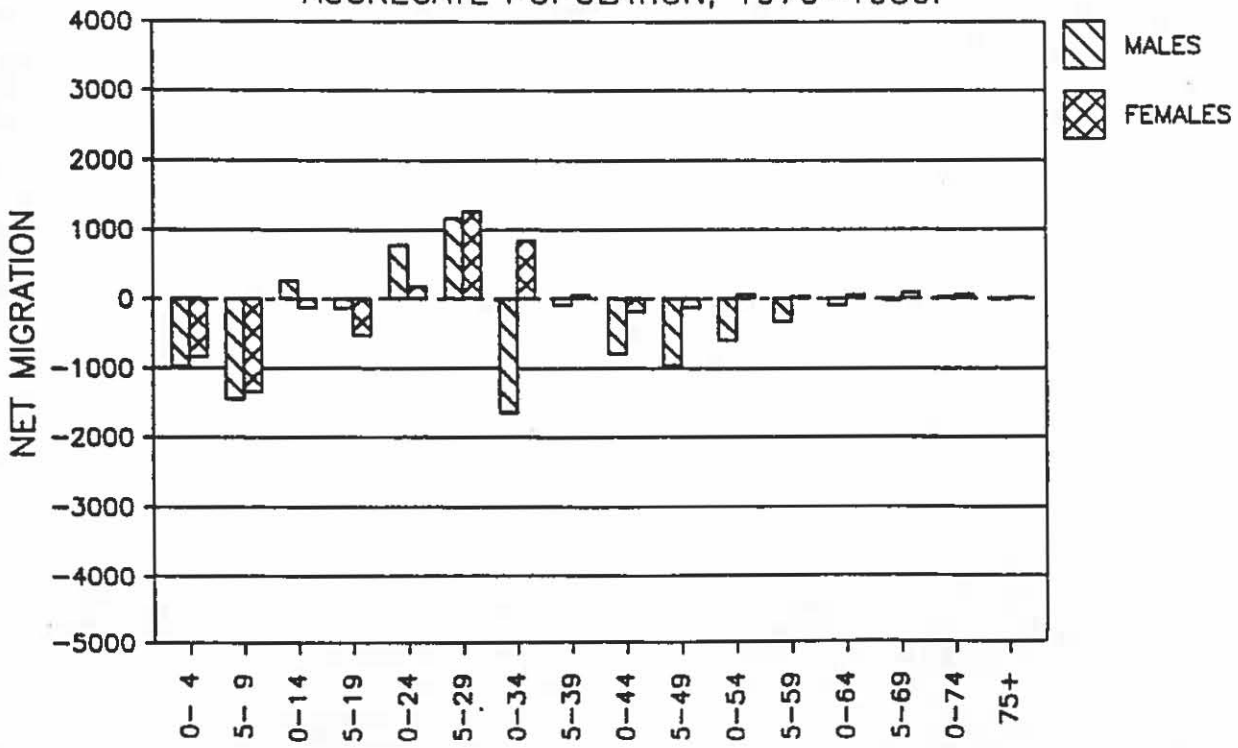


FIGURE V.3 (d)

NET MIGRATION BY AGE & SEX, GUAM.

AGGREGATE POPULATION, 1970–1980.



population under consideration without the influence of migration can now be simulated for each sex. The population at the time of the first census, including the births during the decade are projected to the date of the second census and yield a first estimate of the net migration. A second estimate is obtained by going through the reverse procedure to project the population from the second census back to the time of the first census. The average of both estimates results in the final estimate of net migration. This can subsequently be converted into Net Migration Rates by dividing the number of migrants by the mid-period population.

Comparing the totals that result from this and the previously employed method indicates that there is generally a close correspondence between the two. Under circumstances where a major change in mortality occurs the survival rates may not give an accurate approximation of the actual mortality experience. Such is the case for the Chamorro population between 1940 and 1950. The survival rates that are employed in this case do not account for the excess mortality of this population group on account of World War II and its aftermath. Data for this period suggest that approximately 1,500 Chamorros have died as a direct or indirect consequence of World War II. Taking also a limited level of underregistration of births for the occupation years into account results in a very close match of the two methods. This reasoning can be justified by pointing out that the same methods applied to the aggregate population over this period results in a discrepancy between them that is almost equal to the discrepancy for the Chamorro population alone.

Table V.4 and figure V.2 b suggest that the larger part of the Chamorro migrants are below 40 years of age. The large number of children under the age of 10 suggests that the migrants may be young families.

Data for the aggregate population since 1950 show a less clear picture. Considerable inmigration for males in the ages between 15 to 25 in 1960 and 20 to 30 in later years is being outnumbered by far more outmigration in the higher ages. A possible explanation for this phenomenon would be that inmigrants to Guam after a number of years return to their country of origin or move on to the U.S. mainland. These patterns are known as return- and stepmigration, respectively. The bulk of net inmigration has shifted from the age group 20-24 in 1960 to 25-29 in 1980. Net outmigration for males over the decade 1970-80 manifests itself in ages over 30 and under 10, with a concentration in the age group 30-34. It can safely be assumed that a large portion of these migrants consists of Chamorros.

The migration patterns for females differ slightly from those for males. One notable difference is the fact that most net inmigration of females since 1960 appears to be taking place at somewhat higher ages than for males, i.e. between 20 to 35 for the decade 1950-1960 and 20-40 for later years. Another difference is the net inmigration for females at ages over 50 since 1970.

Net Lifetime Migration.

Utilizing Place of Birth information from the census it becomes possible to distinguish between the directions from which migrants have arrived on Guam. Comparable Place of Birth information in successive censuses also allows for a distinction according to origin and timing of the inmigration. The volumes of the inmigration streams for each period are comparable under the assumption that the average duration of each move remains the same over all periods. Such assumption will hold when the nature of the migration (for example, work) stays the same. Even though the volume of inmigration may be comparable between periods, it does not follow that the amount itself represents the actual number of inmigrants during any given period. This is again dependent on the average duration of a

TABLE V.5
NET LIFETIME MIGRATION, GUAM 1940-1980.

PLACE OF BIRTH	SEX	1940-50	1950-60	1960-70	1970-80
UNITED STATES	MALES	18,900	-5,198	*	*
	FEMALES	4,481	3,131	*	*
	TOTAL	23,380	-2,066	3,663	-284
PHILIPPINES	MALES	6,763	188	*	*
	FEMALES	80	327	*	*
	TOTAL	6,843	516	3,271	7,167
OTHER ASIA	MALES	-7	90	*	*
	FEMALES	2	179	*	*
	TOTAL	-4	269	926	4,473
OTHER	MALES	624	492	*	*
	FEMALES	367	663	*	*
	TOTAL	991	1,155	-980	2,389
NET INMIGRATION	MALES	26,280	-4,428	*	*
	FEMALES	4,930	4,300	*	*
	TOTAL	31,209	-127	6,880	13,745

Note:
* not available

TABLE V.6
MIGRATION STREAM ANALYSIS, GUAM 1975-1980.

	PRIMARY MIGRANTS			SECONDARY MIGRANTS		
FROM	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
U.S.A.	8,206	5,793	13,999	1,093	451	1,544
PHILIPPINES	1,922	2,456	4,378	686	687	1,373
OTHER ASIA	1,004	1,229	2,233	229	470	699
OTHER	695	774	1,469	390	398	788
NET INMIGRATION	11,827	10,252	22,079	2,398	2,006	4,404

FROM	RETURN MIGRANTS MALE	FEMALE	TOTAL
U.S.A.	692	689	1,381
PHILIPPINES	17	18	35
OTHER ASIA	38	28	66
OTHER	109	83	192
RETURNMIGRATION	856	818	1,674

migrants' stay on Guam. If this is relatively short, say two years, then the number of inmigrants over a period of ten years may be as much as five times underestimated, since 80% of the inmigrants for the period will have left before the next census takes place and therefore remain unrecorded.

Place of Birth information from successive censuses will yield 100% accurate inmigration estimates only when all migrants would stay on Guam for the rest of their lives. Although it is not known what the average duration of stay is on Guam, it can be estimated as being significantly less than ten years, based on the knowledge that the military component which makes up the bulk of all migrants is replaced on average every two years.

Keeping in mind that the volume itself is underestimated, table V.5 does yield insight into the pattern of the various migration streams as it developed over time. This table indicates clearly the differences between individual migration streams and between patterns over time. For example, of all migrants from the U.S. lifetime migrants make up a smaller proportion than among other migrant groups, especially those coming from the Philippines. The pattern of migration streams indicates a wave of migrants for the period 1940-1950, with the great majority ofarrivals from the U.S. and the Philippines. A second wave is indicated for the decade 1970-1980, with arrivals coming mainly from the Philippines and other Asian countries.

Migration Streams.

The availability of a cross-tabulation of Place of Birth with Place of Residence five years prior to the census greatly increases the analytical potential of the data. Not only is the time interval of ten years reduced by half, allowing at least a doubling in the accuracy of measurement, it also becomes possible to distinguish between various types of migration behavior.

Three different types can be identified on the basis of such cross-tabulation:

1) Primary migrants; those who were born in the same area where they lived five years prior to the census.

2) Secondary migrants; those who were born in a different area from where they lived five years prior to the census.

3) Return migrants; those who were born on Guam and lived elsewhere five years prior to the census.

It must be kept in mind that all three types of migrants are enumerated on Guam. Using census reports for other areas with comparable cross-tabulations might yield additional information on migrants who have been on Guam, but have left, either as secondary or as return migrants. This falls outside the scope of the present study and is therefore not attempted here.

Table V.6 presents the cross-tabulation from the 1980 census report in a simplified form, that allows comparison with the categories that were used in the previous paragraph. It must be stressed, however, that "lifetime" migration is essentially different from either one of the types that have been identified in the present

paragraph. Moreover, the present tabulation involves only persons over five years of age, while POB tabulations generally involve the total population. The difference between lifetime migrants and the present three types of migrants is illustrated by the number of inmigrants from the U.S.A. While in table V.5 a small negative number of lifetime migrants was reported, table V.6 shows that between 1975 and 1980 about 17,000 inmigrants arrived from the U.S.A. Taking the mortality amongst these inmigrants into account, as has been done in table V.5, these numbers would be still higher. For males multiplication by a factor of 1.010 and for females by 1.006 would result in the original number of inmigrants for the five year period.

Conclusion.

The most useful information on migration at present is to be derived through indirect methods, i.e. using the vital registration system. Such methods yield net migration estimates, the balance of inmigration and outmigration. These methods keep the components of migration hidden, however. Such components as the direction of migration streams and intermediate steps in the path of migration can be elucidated by direct methods, using the variables Place of Birth and Place of Residence five years prior to the census. The number of migrants resulting from these variables is highly dependent on the average duration of stay on Guam, however. Direct methods will therefore yield accurate numerical information only when the average duration of stay for the various categories of migrants can be accounted for.

The applied methods do allow some conclusions to be drawn, however. Two waves of migration have been identified; one taking place between 1945 and 1950 and another, occurring since the early 1970s. The two waves are different in character, however. The first one involves net inmigration of military service personnel and Filipino workers while the second wave consists mainly of net inmigration of Filipinos and "Others" with net outmigration of Chamorros and Caucasians.

The age/sex composition of the net migration streams indicates that inmigrants are generally younger than outmigrants and male inmigrants are younger than female inmigrants. It can also be observed that many of the outmigrants are young families with children just before schoolgoing age.

Finally, it is important to note that two streams of returnmigrants can be identified on the basis of the presently available data. These are a limited stream of people returning to Guam from the U.S. and a large stream of people

coming from the U.S. to Guam who are not found in the net migration numbers, and therefore must have left Guam shortly after they came. It may be inferred that these are military service personnel who, on average, stay for two years on Guam. Their movement constitutes a process of continuous replacement with far-reaching consequences for Guam's population composition.

CHAPTER VI - POPULATION PROJECTIONS

Methodology.

The choice of projection method is principally determined by the available data. The second major consideration involves the purpose of the projection(s) and a third important aspect is the period over which the projection should extend.

The main handicap in developing useful and accurate population projections for Guam is the fact that the available census data are spaced apart in ten year intervals. Especially in the case of Guam where an already complex population composition is undergoing rapid change there is a great need for updating demographic information, for example every five years. This would allow more accurate determination of past and future courses of population trends. On the other hand, it is fortunate that the population trends that were identified in the previous chapters have been going on for at least 25 years, so that information from the last three censuses can be used to determine the future courses of these trends. The fact that age- and sex-specific rates for fertility, mortality as well as migration are available allows the use of component methods. Moreover, the projection series are to provide insight into the size and composition of Guam's population at some future date, which means that component methods are called for.

The component of mortality is represented by Cohort Survival Rates, derived from the l(x) function of pairs of life tables, spaced ten years apart. The migration component can be either represented by absolute numbers or Net Migration Rates. In most instances Cohort (Age Specific) Fertility Rates are to be preferred over Period (Age Specific) Fertility Rates. There are two reasons why the latter type will be employed here; first, the ten year interval makes it

more difficult to work with cohorts that usually embrace five years, and second, the impact of migration is such that a substantial part of the population in a particular cohort was not on Guam say, ten or twenty years earlier. Identified cohorts, therefore, are largely not "true" cohorts. "True" in the sense that they consist only of all the individuals, born on Guam in a specified time period of, say, five years, who have survived until some specified point in time, like a census date. These two arguments result in the theoretical advantages of Cohort Fertility Rates to be negated.

The various projection series make use of identified trends up to twenty years back in time. It would therefore be appropriate to use a projection period that is a multiple of twenty years. Since the choice of a component method allows long-range projections, a projection period of 40 years is chosen, i.e. from 1980 to 2020.

The algorithm that is employed in the present method of projection basically works as follows: first the number of male and female births occurring during two successive five-year periods is computed using the Age Specific Fertility Rates in conjunction with the appropriate age groups of women. These births, along with the rest of the population, are subsequently subjected to the mortality experience, as represented by Cohort Survival Rates, derived from the appropriate life tables. In the third step the average of the initial population and the surviving population is multiplied by the Net Migration Rates to calculate the number of migrants in each age group over a ten-year period. By applying the number of births during the first five-year period, half of the mortality and half of the migration for the ten-year period an estimate of the mid-decade population is obtained. The remaining births, deaths and migrants are then applied to this population to arrive at the projected population at the end of the decade.

The validity of this algorithm has first been tested. A projection was done over the period 1960 to 1980, using observed values for the three components. The resulting values for 1980 were compared to the 1980 census data. The observed difference between the projected population total and the actual was 1% for females and 3% for males.

Assumptions.

Four projection series have been developed, each with a particular set of assumptions. The first series is based on developments that have taken place over the period 1960-1980. Because simple extrapolation of the observed change for either fertility and mortality would result in values that are impossible or unlikely to ever occur, the observed change has been made to decline at a constant percentage for each reference period. For example, the pattern of change in Age Specific Fertility Rates that was observed between 1960 and 1980 has been used to derive the ASFRs for 2000 and 2020, but the magnitude of this change is only half that much for the period 1980-2000 and a quarter as much for the period 2000-2020. The levels for the years 1990 and 2010 are determined through interpolation of the Total Fertility Rates for the years 1980 and 2000, and 2000 and 2020, respectively. The pattern of ASFRs for 1980 is used to arrive at the values for 1990, and the pattern for 2000 is used to arrive at those for 2010. Basically the same principle is being used to arrive at future Age Specific Mortality Rates, with the small difference that the change over the period 1960-1980 is directly used to derive the change for subsequent ten year periods, with an identical decrease in magnitude. The component of migration in this case is determined as 75% of the Net Migration Rates for the previous ten years plus 25% of the NMRs for the period that began twenty years earlier.

TABLE VI.1
ASSUMPTIONS FOR THE POPULATION PROJECTIONS.

	FERTILITY Age Specific Fertility Rates	MORTALITY Life Table Survival Rates	MIGRATION Age Specific Net Migration Rates
SERIES 1	decline based on 1960-80 *	change based on 1960-80 *	change based on 1960-80 ***
SERIES 2	decline based on 1970-80 **	change based on 1970-80 **	constant as of 1970-80
SERIES 3	constant as of 1980	constant as of 1980	constant as of 1970-80
SERIES 4	constant as of 1980	constant as of 1980	zero net migration

Notes:
* Change decreases 50% every twenty years.
** Change decreases 67% every ten years.
*** N.M.R.{x;x+10}=25% N.M.R.{x-20;x-10}+75% N.M.R.{x-10;x}.

TABLE VI.2
PROJECTED AGE SPECIFIC FERTILITY RATES

SERIES 1

	AGE SPECIFIC FERTILITY RATES						
AGE GROUP	1960	1970	1980	1990	2000	2010	2020
15 to 19	94.8	92.5	77.0	72.2	69.7	67.6	66.5
20 to 24	354.1	272.3	197.3	168.2	153.6	142.3	136.6
25 to 29	284.1	240.7	179.7	157.7	146.7	137.7	133.2
30 to 34	225.7	146.6	110.3	91.5	82.1	75.1	71.6
35 to 39	142.0	105.1	51.4	40.5	35.0	31.3	29.4
40 to 44	57.7	48.5	18.8	14.5	12.4	11.0	10.3
45 to 49	8.4	6.7	1.5	1.1	.9	.8	.7
TFR	5834.2	4562.6	3179.5	2728.0	2502.2	2328.5	2241.6
% DECLINE (10 y.)		21.8%	30.3%	14.2%	8.3%	6.9%	3.7%
% DECLINE (20 y.)		45.5%	40.2%	21.3%	14.6%	10.4%	

SERIES 2

	AGE SPECIFIC FERTILITY RATES					
AGE OF MOTHER	1970	1980	1990	2000	2010	2020
15 to 19	92.5	77.0	72.7	71.3	70.9	70.7
20 to 24	272.3	197.3	179.2	173.7	171.9	171.3
25 to 29	240.7	179.7	164.5	159.9	158.4	157.9
30 to 34	146.6	110.3	101.1	98.4	97.5	97.2
35 to 39	105.1	51.4	42.6	40.2	39.5	39.2
40 to 44	48.5	18.8	14.9	13.9	13.6	13.5
45 to 49	6.7	1.5	1.1	1.0	1.0	1.0
TFR	4562.6	3179.5	2881.0	2792.0	2763.4	2753.9
% DECLINE		30.3%	9.4%	3.1%	1.0%	.3%

The other projection series are either based on change occurring during the decade 1970-1980 and/or constancy in the most recently observed values. The various combinations of possible developments that make up the scenarios are tabulated in table VI.1. A scenario generally is developed on the basis of probable future developments and does not incorporate any assumptions that are unlikely to occur. The fourth projection series in the present case does not represent a very likely scenario, but is included because of its theoretical and comparative value. It represents the circumstances under which a stable population would develop. Also, comparison between series 4 and series 3 indicates the relative influence of the net migration component. Comparison between series 3 and series 2 provides insight in the contribution of both the fertility and mortality component. It may be noted that the change in mortality is far less pronounced than the change in fertility, and consequently does not exert as much influence. This is in agreement with the earlier observation that Guam's population finds itself in the third phase of the Demographic Transition. Table VI.2 shows the ASFRs resulting from the above mentioned algorithms in projection series 1 and 2, respectively.

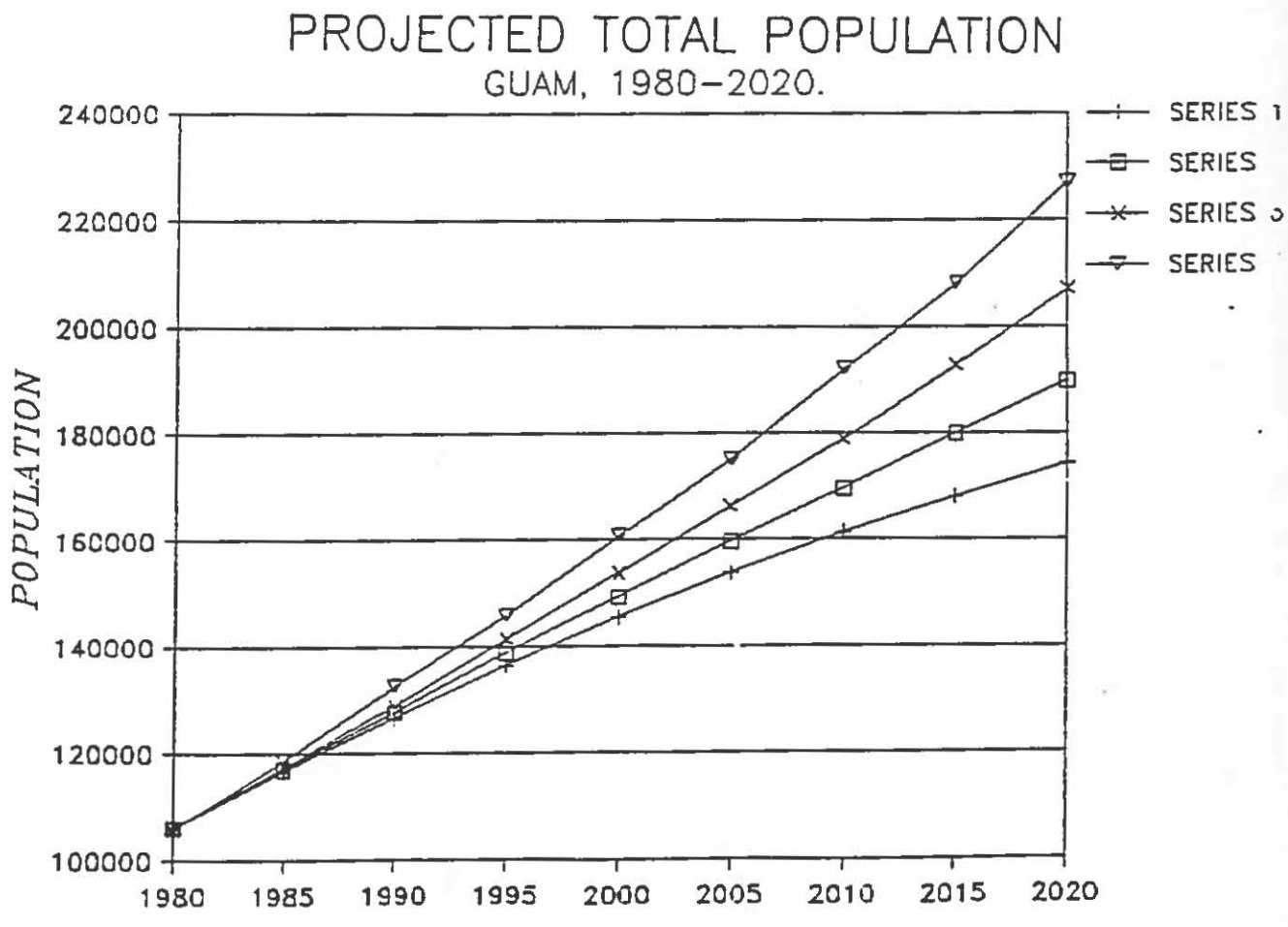
Size and Composition of the Projected Population.

As table VI.3 and figure VI.1 indicate, projection series 1 results in the most conservative estimates. It combines the lowest fertility estimate of all series with the highest net outmigration. These powerful components more than offset the higher survival rates that characterize this series. The projected total of 174,396 in the year 2020 implies an average annual growth rate of 1.25% over these forty years. This series represents the "low variant". The second series constitutes a medium variant. It results in a projected total of 189,779 in the year 2020, or an annual growth rate of 1.46%. Series 3, the high variety,

TABLE VI.3
PROJECTED POPULATION TOTALS, GUAM 1980-2020.

YEAR	SERIES 1	SERIES 2	SERIES 3	SERIES 4	MATHEMATICAL EXTRAPOLATION ARITHM.	GEOM.	EXPON.
1980	105,979	105,979	105,979	105,979	105,979	105,979	105,979
1985	116,495	116,882	117,136	118,730	117,623	118,340	118,198
1990	126,386	127,525	128,740	132,622	129,267	132,142	131,825
1995	136,329	138,660	141,425	145,933	140,912	147,554	147,024
2000	145,393	149,274	153,772	160,936	152,556	164,764	163,975
2005	153,745	159,588	166,416	175,311	164,200	183,981	182,881
2010	161,358	169,626	179,070	192,292	175,844	205,439	203,966
2015	168,089	179,933	192,888	208,204	187,489	229,401	227,483
2020	174,396	189,779	207,204	227,081	199,133	256,156	253,710
ANNUAL r:	1.2452	1.4565	1.6762	1.9052	1.5266	2.2309	2.1824

FIGURE VI.1



allows the population to grow at an annual rate of 1.68%, to a total of 207,204. In the unlikely event that there would be no change in mortality or fertility since 1980 and there would be no net migration, Guam's population would grow to 227,081 or at 1.91% annually. It must be noted that the annual rates of growth at the beginning of the projection period are higher than the average annual growth rates.

For comparative purposes three more series of projected population totals are tabulated, computed by means of mathematical extrapolation. The basis for the extrapolation are the annual growth rates for the decade 1970-1980. It will be clear that the mathematical approximations yield results that show increasing discrepancies with the other four series as the length of the projection progresses. These values are shown here since the mathematical series are at present the most widely used projection methods on Guam.

Tables VI.4 a-d present the results of the four projection series by age and sex. The same information, for ten-year intervals is visualized in figures VI.2-5 in the form of age pyramids. Figure VI.5 represents the "stable" variant. It can be observed that over the period of 40 years the population structure would become very well balanced. Only in the ages over 40 can slight aberrations be noticed. Turning to figure VI.4 the influence of migration becomes clear; the male population structure attains a saw-toothed shape with a marked excess in the age group 20-30. Compared to figure VI.5 it also becomes clear that this variant indicates a relative deficit in males at ages over 40. The age structure for females, on the other hand, shows an increasing excess of females at the higher ages, compared to the stable variant, along with a surplus in the age groups from 20 to 35. Overall, this projection series results in a situation where the male population is on average notably younger than the female population.

FIGURE VI.2 (a)

POPULATION COMPOSITION, GUAM.

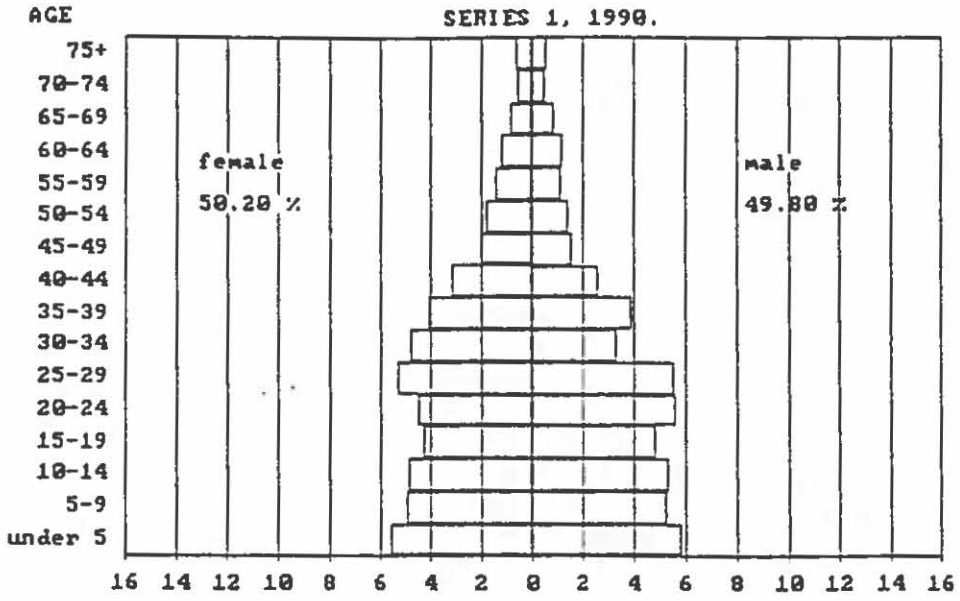


FIGURE VI.2 (b)

POPULATION COMPOSITION, GUAM.

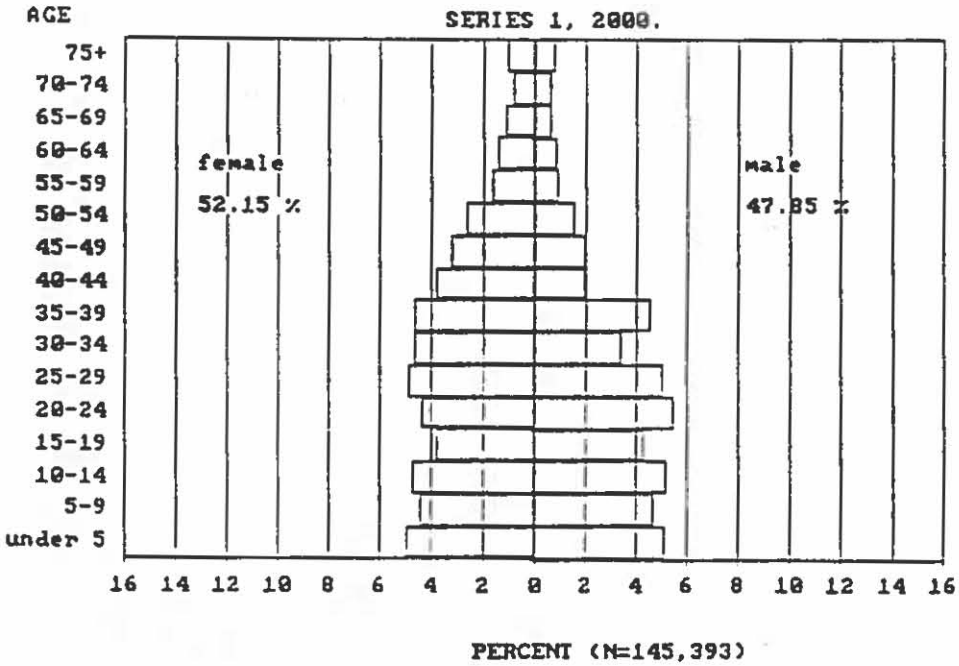


FIGURE VI.2 (c)

POPULATION COMPOSITION, GUAM.

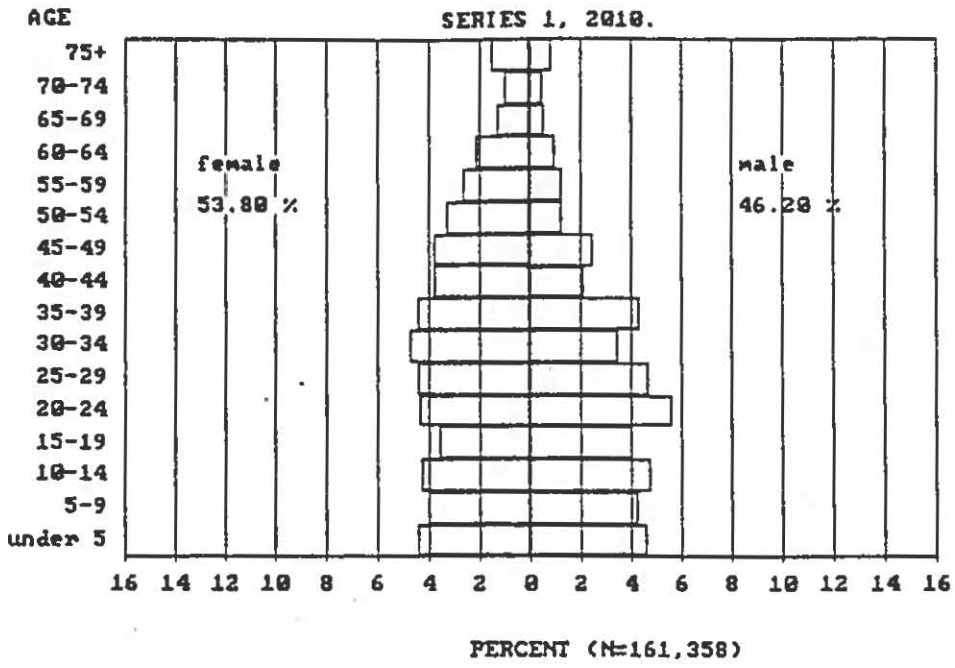


FIGURE VI.2 (d)

POPULATION COMPOSITION, GUAM.

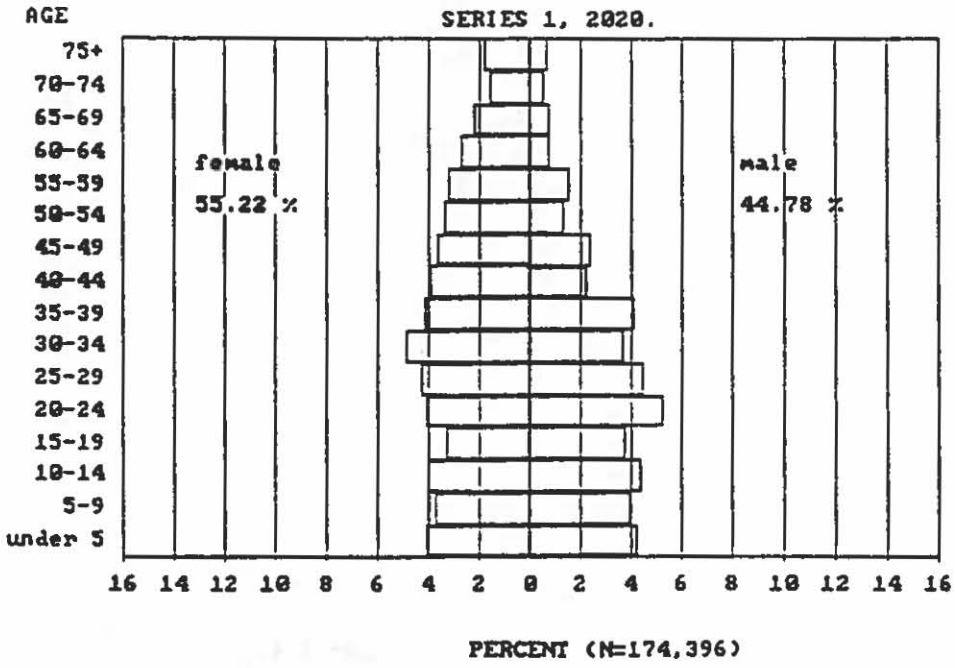


FIGURE VI.3 (a)
POPULATION COMPOSITION, GUAM.

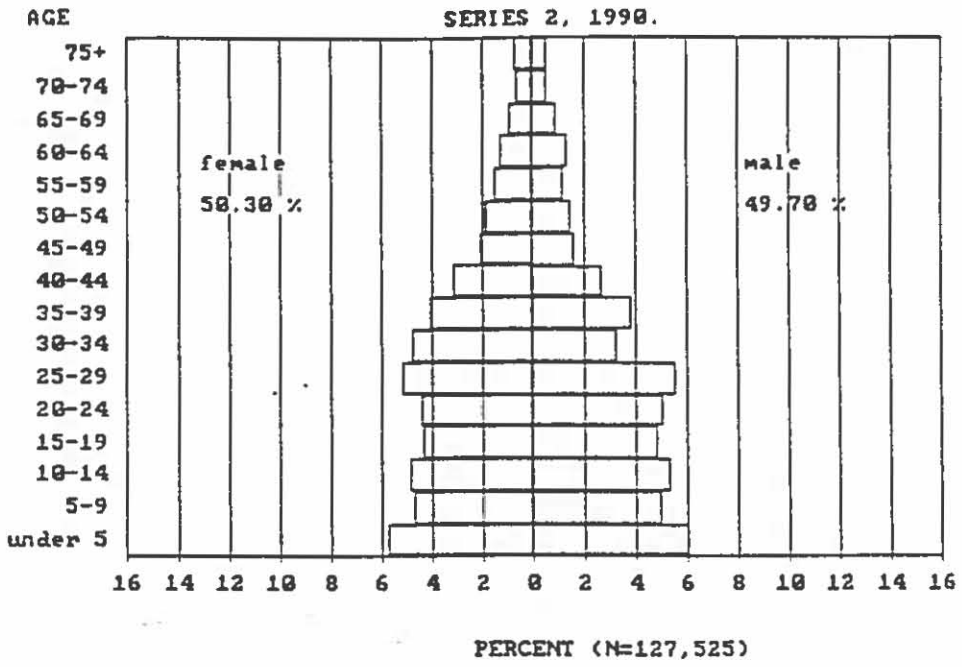


FIGURE VI.3 (b)
POPULATION COMPOSITION, GUAM.

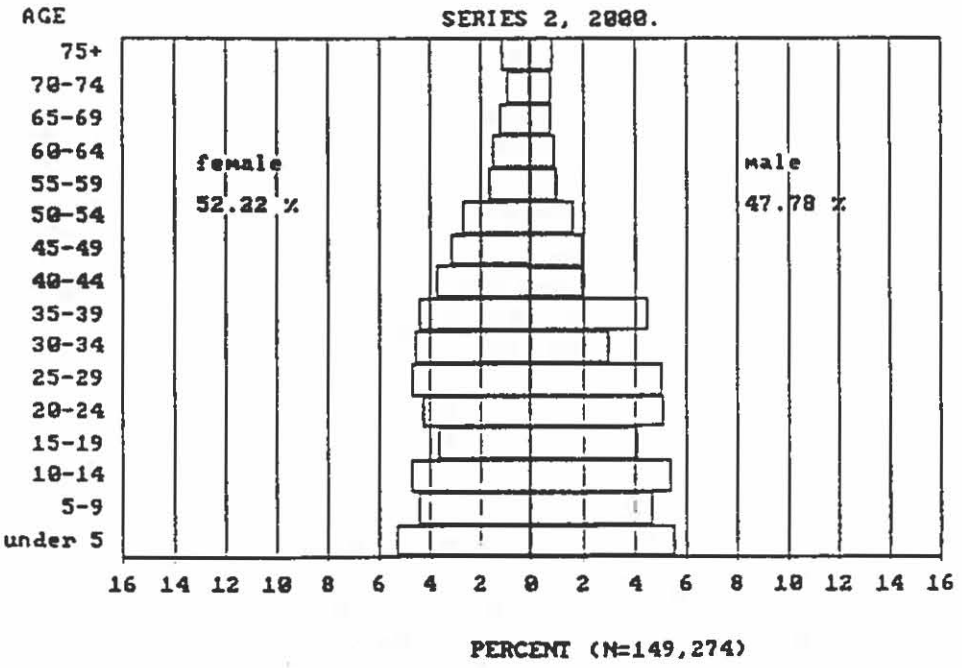


FIGURE VI.3 (c)
POPULATION COMPOSITION, GUAM.

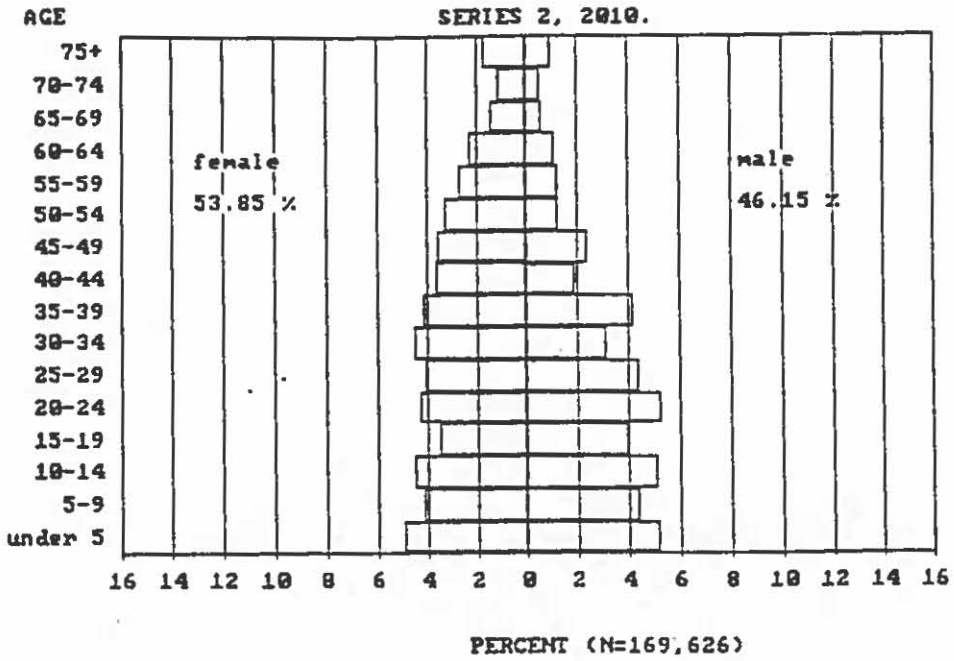


FIGURE VI.3 (d)
POPULATION COMPOSITION, GUAM.

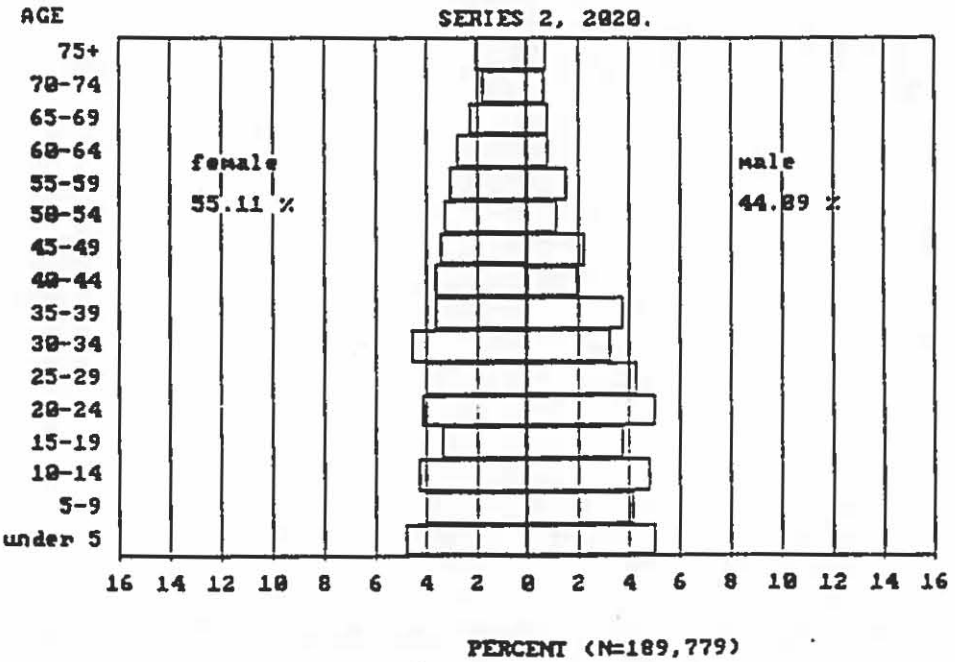


FIGURE VI.4 (a)

POPULATION COMPOSITION, GUAM.

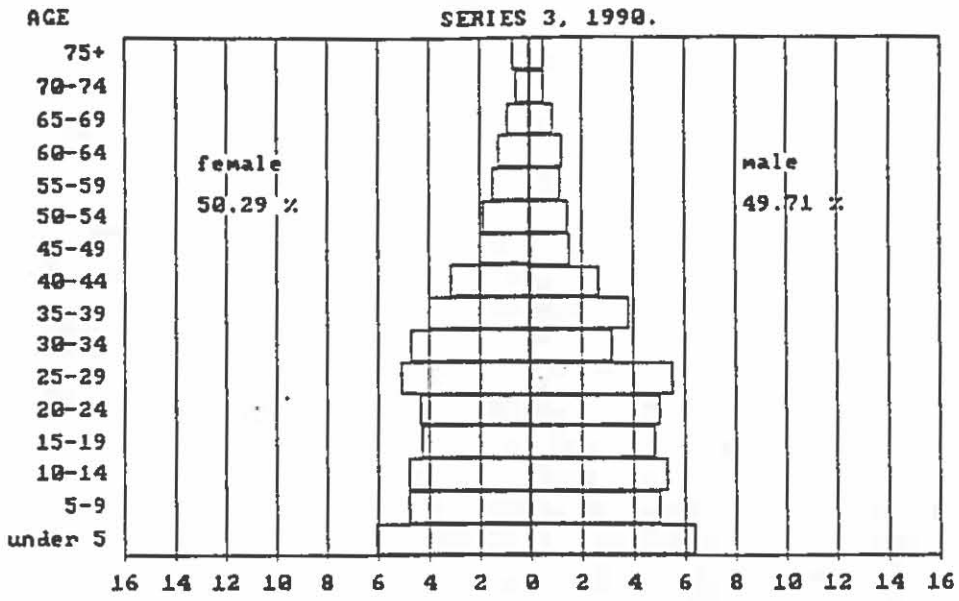


FIGURE VI.4 (b)

POPULATION COMPOSITION, GUAM.

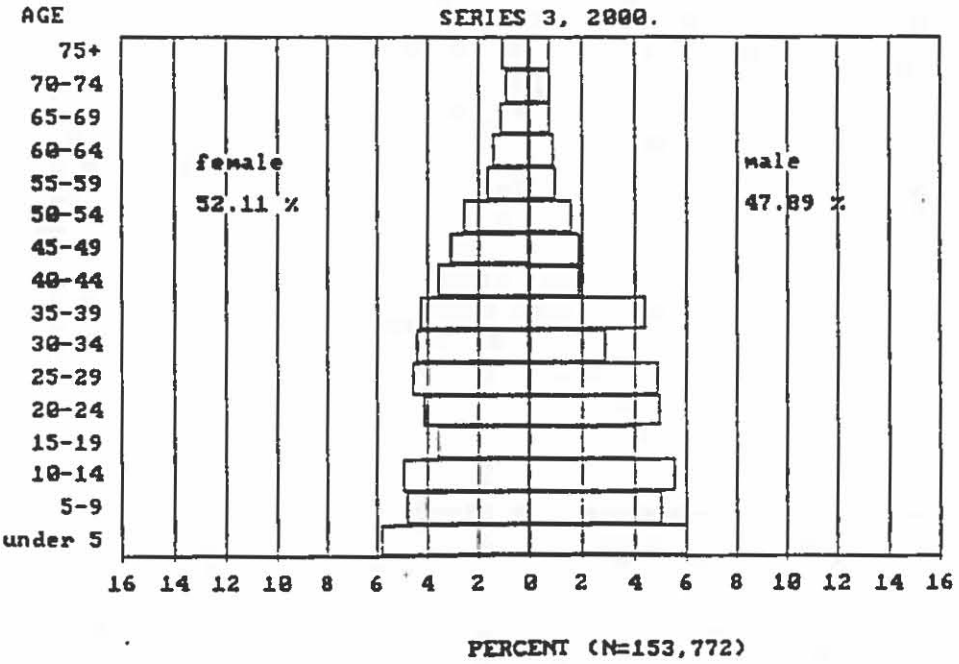


FIGURE VI.4 (c)

POPULATION COMPOSITION, GUAM.

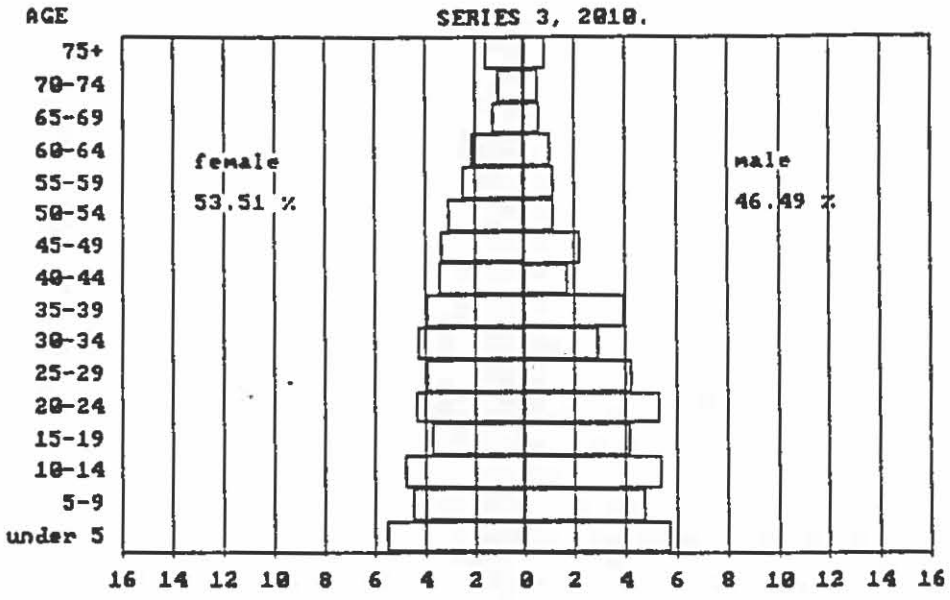


FIGURE VI.4 (d)

POPULATION COMPOSITION, GUAM.

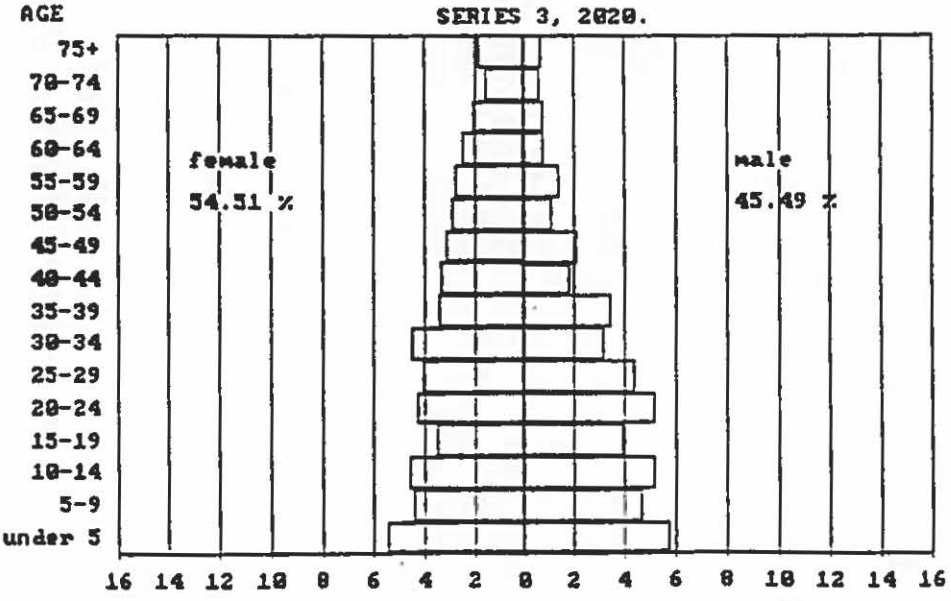


FIGURE VI.5 (a)

POPULATION COMPOSITION, GUAM.

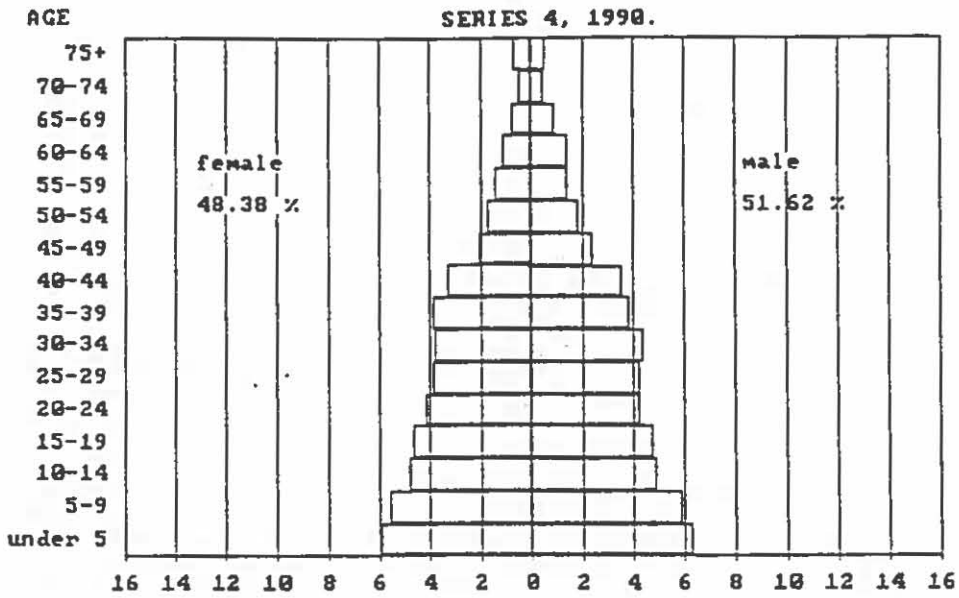


FIGURE VI.5 (b)

POPULATION COMPOSITION, GUAM.

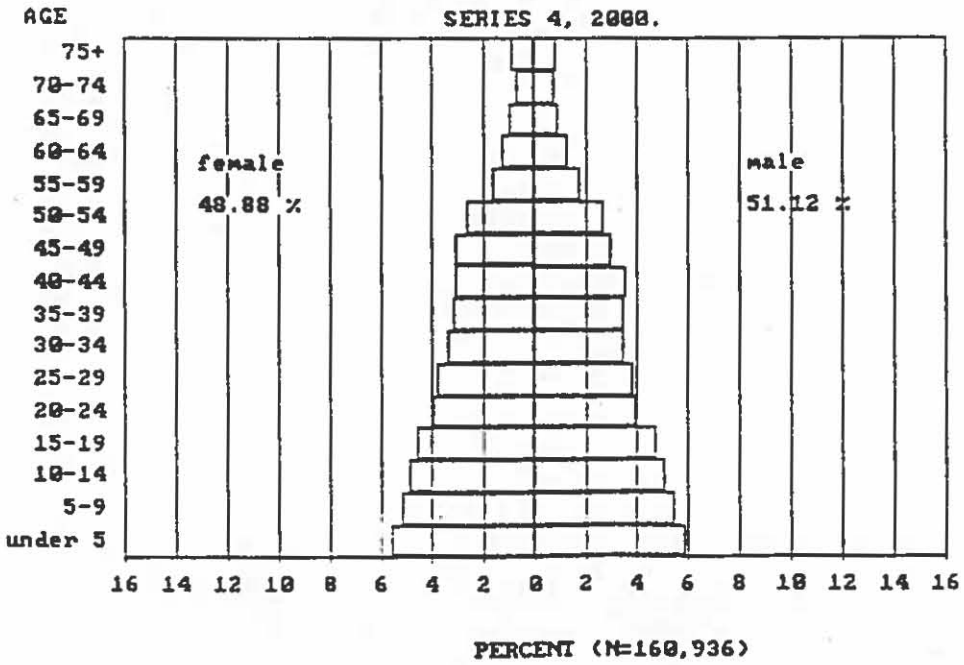


FIGURE VI.5 (c)

POPULATION COMPOSITION, GUAM.

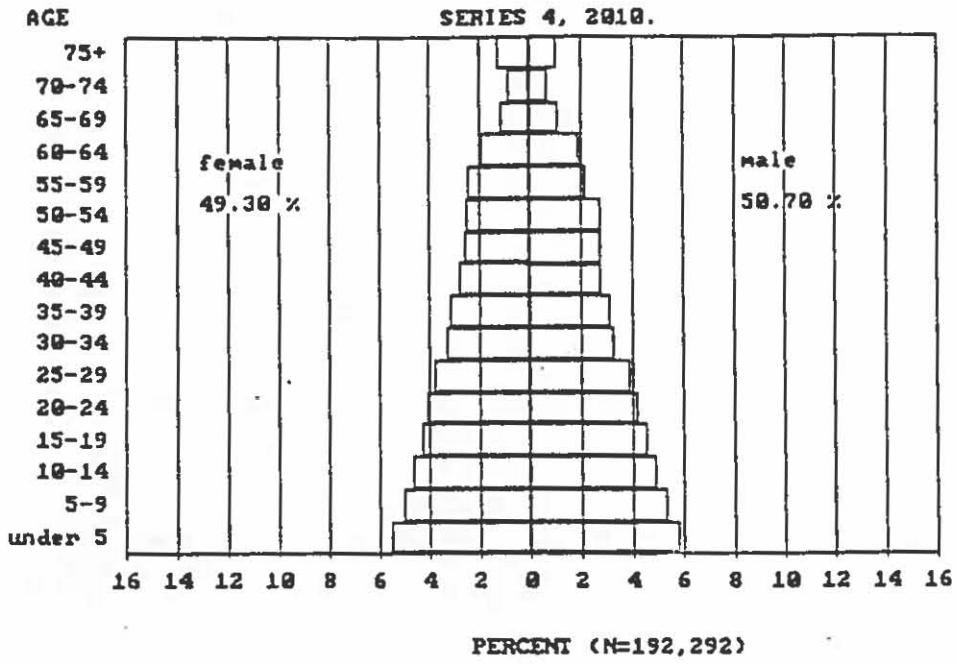
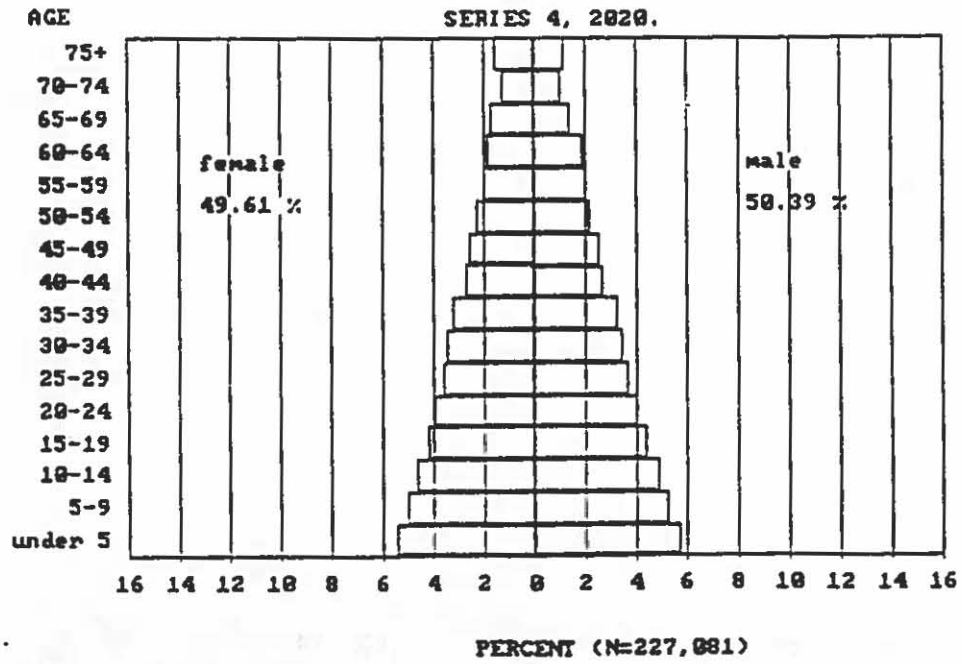


FIGURE VI.5 (d)

POPULATION COMPOSITION, GUAM.



As explained in chapter II, the age structure without the distinction by sex can be summarized by means of Dependency Ratios. These have been computed and plotted in table VI.5 and figures VI.6 a-d for the period 1960-2020. Toward the year 2020 series 4 results in the highest Dependency Ratios, with a tendency to rise more and faster than all other series. From figure VI.6 c it can be observed that the effect of migration results in a continuing decline in the relative proportion of persons in the younger age groups, while the values for elderly people show a substantial increase.

The structure of the population, resulting from projection series 3, is similar to the one resulting from series 2. The influence of declining fertility and changing mortality that is responsible for any differences between series 3 and 2 appears to be limited to the ages under 15. The substantially lower numbers in these age groups for series 2, as compared to series 3, can largely be attributed to the decline in fertility.

Series 1 reflects a longer and stronger continuation of the observed decline in fertility. This is clearly reflected in its nearly constrictive population structure in figure VI.2 a. Like in the other projection series the relative proportion of aged people increases significantly after 1990. The resulting total Dependency Ratio is the lowest among the various series. If it were not for the migration component, series 1,2 and 3 would result in substantially higher Dependency Ratios.

Conclusion.

Guam's population will not increase as fast and as much as is generally believed. Although indeed there is a high level of inmigration, this is more than compensated by a still higher level of outmigration, albeit among different subgroups in Guam's population. Projecting identified trends of the three

TABLE VI.4 (a)
POPULATION PROJECTIONS, GUAM 1980-2020.

SERIES 1

AGE GROUP	1985 MALE	FEMALE	TOTAL	1990 MALE	FEMALE	TOTAL
0- 4	7,312	6,879	14,191	7,389	7,067	14,456
5- 9	6,686	6,277	12,963	6,643	6,232	12,875
10-14	6,293	5,817	12,110	6,752	6,172	12,924
15-19	6,493	5,580	12,073	6,128	5,461	11,590
20-24	6,440	5,914	12,354	7,144	5,658	12,801
25-29	5,136	5,585	10,722	7,023	6,682	13,705
30-34	5,066	5,161	10,227	4,265	6,081	10,345
35-39	4,102	4,198	8,300	4,940	5,192	10,132
40-44	2,703	2,692	5,394	3,362	3,961	7,323
45-49	2,209	2,340	4,549	2,034	2,525	4,560
50-54	1,822	1,933	3,754	1,783	2,282	4,065
55-59	1,880	1,643	3,523	1,491	1,850	3,341
60-64	1,342	1,202	2,543	1,553	1,546	3,100
65-69	807	819	1,626	1,087	1,129	2,216
70-74	563	587	1,150	641	732	1,372
75+	433	582	1,015	709	873	1,583
ALL AGES	59,285	57,210	116,495	62,944	63,442	126,386

AGE GROUP	1995 MALE	FEMALE	TOTAL	2000 MALE	FEMALE	TOTAL
0- 4	7,618	7,171	14,790	7,529	7,174	14,703
5- 9	7,486	6,959	14,444	6,882	6,463	13,346
10-14	6,485	5,885	12,370	7,582	6,851	14,433
15-19	7,414	6,265	13,678	6,329	5,538	11,867
20-24	6,756	6,265	13,021	8,068	6,357	14,425
25-29	6,079	6,218	12,297	7,376	7,067	14,443
30-34	6,845	6,728	13,573	5,029	6,778	11,806
35-39	3,618	5,777	9,395	6,670	6,773	13,443
40-44	3,949	4,919	8,868	2,981	5,475	8,456
45-49	2,821	3,899	6,721	2,981	4,648	7,628
50-54	1,719	2,438	4,157	2,299	3,838	6,137
55-59	1,510	2,171	3,681	1,421	2,353	3,774
60-64	1,236	1,755	2,991	1,262	2,064	3,326
65-69	1,258	1,395	2,653	1,015	1,666	2,681
70-74	838	968	1,806	1,014	1,262	2,276
75+	830	1,054	1,884	1,139	1,511	2,650
ALL AGES	66,463	69,866	136,329	69,575	75,818	145,393

TABLE VI.4 (a) CONTINUED
SERIES 1

AGE GROUP	2005 MALE	FEMALE	TOTAL	2010 MALE	FEMALE	TOTAL
0- 4	7,672	7,219	14,891	7,503	7,153	14,656
5- 9	7,625	7,065	14,690	6,948	6,519	13,467
10-14	6,715	6,102	12,817	7,720	6,957	14,677
15-19	8,350	6,955	15,305	6,549	5,741	12,290
20-24	6,972	6,359	13,331	9,108	7,059	16,167
25-29	6,868	6,988	13,856	7,607	7,178	14,785
30-34	7,189	7,118	14,308	5,685	7,617	13,302
35-39	4,262	6,440	10,702	7,005	7,170	14,175
40-44	5,330	6,415	11,746	3,506	6,103	9,609
45-49	2,498	5,387	7,885	4,021	6,059	10,080
50-54	2,514	4,484	6,999	2,032	5,300	7,331
55-59	1,942	3,644	5,586	2,073	4,325	6,398
60-64	1,174	2,228	3,402	1,617	3,459	5,076
65-69	1,018	1,859	2,877	960	2,112	3,072
70-74	779	1,425	2,204	817	1,677	2,495
75+	1,329	1,818	3,147	1,389	2,389	3,778
ALL AGES	72,240	81,505	153,745	74,541	86,817	161,358

AGE GROUP	2015 MALE	FEMALE	TOTAL	2020 MALE	FEMALE	TOTAL
0- 4	7,661	7,207	14,868	7,519	7,165	14,684
5- 9	7,601	7,046	14,647	6,937	6,507	13,444
10-14	6,780	6,155	12,935	7,698	6,939	14,637
15-19	8,494	7,064	15,557	6,613	5,792	12,405
20-24	7,215	6,591	13,806	9,258	7,170	16,429
25-29	7,752	7,761	15,513	7,871	7,441	15,312
30-34	7,414	7,232	14,646	6,414	8,461	14,875
35-39	4,819	7,241	12,060	7,223	7,286	14,509
40-44	5,599	6,796	12,395	3,966	6,866	10,831
45-49	2,940	6,010	8,950	4,224	6,424	10,649
50-54	3,394	5,851	9,245	2,393	5,919	8,312
55-59	1,717	5,035	6,752	2,800	5,648	8,448
60-64	1,715	4,098	5,813	1,431	4,783	6,214
65-69	1,305	3,118	4,423	1,403	3,888	5,291
70-74	736	1,806	2,543	1,049	2,816	3,865
75+	1,308	2,628	3,936	1,292	3,200	4,492
ALL AGES	76,449	91,640	168,089	78,090	96,306	174,396

TABLE VI.4 (b)
POPULATION PROJECTIONS, GUAM 1980-2020.

SERIES 2

AGE GROUP	1985 MALE	FEMALE	TOTAL	1990 MALE	FEMALE	TOTAL
0- 4	7,230	6,819	14,048	7,750	7,307	15,057
5- 9	6,750	6,288	13,038	6,385	6,024	12,409
10-14	6,349	5,855	12,204	6,879	6,194	13,073
15-19	6,170	5,583	11,753	6,241	5,536	11,777
20-24	6,496	5,841	12,337	6,502	5,663	12,165
25-29	5,092	5,597	10,689	7,135	6,536	13,671
30-34	5,057	5,151	10,208	4,175	6,103	10,279
35-39	4,167	4,233	8,399	4,922	5,172	10,094
40-44	2,719	2,738	5,457	3,490	4,031	7,521
45-49	2,263	2,399	4,662	2,066	2,617	4,684
50-54	1,874	1,978	3,852	1,889	2,399	4,288
55-59	1,959	1,701	3,660	1,593	1,940	3,532
60-64	1,404	1,245	2,649	1,703	1,659	3,362
65-69	853	855	1,708	1,204	1,212	2,416
70-74	583	610	1,194	724	799	1,523
75+	424	600	1,024	729	945	1,673
ALL AGES	59,389	57,494	116,882	63,386	64,139	127,525

AGE GROUP	1995 MALE	FEMALE	TOTAL	2000 MALE	FEMALE	TOTAL
0- 4	7,995	7,535	15,529	8,332	7,851	16,183
5- 9	7,903	7,200	15,103	7,069	6,658	13,727
10-14	6,278	5,713	11,991	8,055	7,094	15,149
15-19	7,275	6,284	13,559	6,171	5,402	11,573
20-24	6,931	6,287	13,218	7,667	6,374	14,040
25-29	5,499	6,229	11,728	7,613	7,035	14,647
30-34	6,947	6,563	13,510	4,509	6,792	11,301
35-39	3,584	5,826	9,410	6,760	6,590	13,351
40-44	3,952	4,955	8,907	3,001	5,550	8,552
45-49	2,980	4,035	7,015	3,004	4,739	7,743
50-54	1,785	2,567	4,352	2,487	4,039	6,526
55-59	1,654	2,340	3,994	1,518	2,519	4,037
60-64	1,370	1,887	3,257	1,440	2,283	3,723
65-69	1,443	1,545	2,988	1,176	1,838	3,014
70-74	967	1,077	2,044	1,227	1,445	2,672
75+	885	1,171	2,056	1,294	1,743	3,037
ALL AGES	67,447	71,213	138,660	71,323	77,952	149,274

TABLE VI.4 (b) CONTINUED
SERIES 2

AGE GROUP	2005 MALE	FEMALE	TOTAL	2010 MALE	FEMALE	TOTAL
0- 4	8,487	7,997	16,484	8,839	8,326	17,165
5- 9	8,497	7,736	16,233	7,507	7,067	14,574
10-14	6,950	6,314	13,265	8,661	7,622	16,283
15-19	8,519	7,197	15,715	6,832	5,971	12,803
20-24	6,854	6,135	12,988	8,978	7,300	16,277
25-29	6,484	7,010	13,495	7,528	6,865	14,392
30-34	7,411	7,064	14,475	5,316	7,645	12,961
35-39	3,870	6,484	10,354	7,212	7,093	14,305
40-44	5,428	6,314	11,742	3,241	6,177	9,419
45-49	2,563	5,557	8,120	4,125	6,041	10,166
50-54	2,595	4,650	7,244	2,140	5,563	7,703
55-59	2,180	3,939	6,118	2,207	4,563	6,769
60-64	1,306	2,451	3,757	1,898	3,844	5,741
65-69	1,221	2,127	3,348	1,121	2,388	3,509
70-74	946	1,634	2,580	1,038	1,989	3,027
75+	1,531	2,139	3,670	1,646	2,884	4,530
ALL AGES	74,841	84,747	159,588	78,289	91,337	169,626

AGE GROUP	2015 MALE	FEMALE	TOTAL	2020 MALE	FEMALE	TOTAL
0- 4	9,127	8,600	17,727	9,584	9,027	18,611
5- 9	9,014	8,204	17,218	8,073	7,601	15,674
10-14	7,381	6,702	14,083	9,188	8,083	17,271
15-19	9,160	7,733	16,893	7,256	6,338	13,594
20-24	7,588	6,781	14,369	9,653	7,843	17,497
25-29	7,593	8,029	15,622	8,334	7,587	15,922
30-34	7,329	6,893	14,222	6,225	8,755	14,981
35-39	4,563	7,298	11,861	7,132	6,922	14,053
40-44	5,791	6,796	12,587	3,822	6,953	10,775
45-49	2,768	6,185	8,953	4,401	6,502	10,904
50-54	3,564	5,927	9,491	2,311	6,193	8,504
55-59	1,875	5,426	7,301	3,032	5,817	8,848
60-64	1,900	4,439	6,339	1,633	5,295	6,928
65-69	1,610	3,581	5,191	1,631	4,325	5,956
70-74	902	2,123	3,025	1,370	3,350	4,720
75+	1,558	3,215	4,773	1,555	3,988	5,543
ALL AGES	81,722	97,933	179,655	85,199	104,580	189,779

TABLE VI.4 (C)
POPULATION PROJECTIONS, GUAM 1980-2020.

SERIES 3

AGE GROUP	1985 MALE	FEMALE	TOTAL	1990 MALE	FEMALE	TOTAL
0- 4	7,386	6,982	14,368	8,294	7,839	16,133
5- 9	6,747	6,285	13,033	6,501	6,163	12,665
10-14	6,347	5,854	12,201	6,874	6,189	13,063
15-19	6,168	5,583	11,752	6,237	5,534	11,771
20-24	6,496	5,841	12,338	6,498	5,664	12,162
25-29	5,093	5,596	10,690	7,136	6,536	13,672
30-34	5,059	5,151	10,210	4,179	6,102	10,281
35-39	4,167	4,230	8,398	4,925	5,171	10,097
40-44	2,719	2,733	5,452	3,491	4,027	7,518
45-49	2,262	2,393	4,655	2,066	2,608	4,675
50-54	1,871	1,975	3,846	1,887	2,387	4,275
55-59	1,953	1,700	3,653	1,587	1,933	3,520
60-64	1,400	1,244	2,644	1,693	1,656	3,349
65-69	849	852	1,702	1,196	1,211	2,407
70-74	577	606	1,183	718	794	1,512
75+	418	596	1,014	710	932	1,642
ALL AGES	59,514	57,622	117,136	63,995	64,746	128,740

AGE GROUP	1995 MALE	FEMALE	TOTAL	2000 MALE	FEMALE	TOTAL
0- 4	8,839	8,356	17,194	9,378	8,863	18,242
5- 9	8,454	7,720	16,174	7,780	7,376	15,156
10-14	6,390	5,844	12,234	8,613	7,601	16,214
15-19	7,267	6,279	13,546	6,279	5,525	11,804
20-24	6,927	6,284	13,212	7,656	6,369	14,025
25-29	5,499	6,228	11,728	7,609	7,032	14,641
30-34	6,950	6,562	13,512	4,512	6,791	11,302
35-39	3,588	5,820	9,408	6,767	6,588	13,355
40-44	3,955	4,942	8,897	3,005	5,540	8,545
45-49	2,980	4,016	6,996	3,006	4,716	7,722
50-54	1,781	2,552	4,333	2,486	4,007	6,493
55-59	1,647	2,325	3,972	1,511	2,498	4,009
60-64	1,360	1,878	3,238	1,428	2,266	3,694
65-69	1,427	1,536	2,963	1,162	1,828	2,990
70-74	947	1,064	2,011	1,206	1,431	2,637
75+	854	1,152	2,006	1,239	1,703	2,942
ALL AGES	68,864	72,560	141,425	73,637	80,135	153,772

TABLE VI.4 (c) CONTINUED
SERIES 3

AGE GROUP	2005 MALE	FEMALE	TOTAL	2010 MALE	FEMALE	TOTAL
0- 4	9,725	9,193	18,918	10,378	9,808	20,187
5- 9	9,559	8,729	18,288	8,560	8,115	16,676
10-14	7,647	6,993	14,640	9,738	8,595	18,333
15-19	9,105	7,713	16,818	7,515	6,612	14,126
20-24	6,974	6,274	13,248	9,592	7,823	17,415
25-29	6,479	7,004	13,483	7,660	7,020	14,680
30-34	7,411	7,060	14,471	5,315	7,637	12,952
35-39	3,873	6,477	10,351	7,216	7,088	14,304
40-44	5,433	6,297	11,730	3,245	6,166	9,410
45-49	2,565	5,526	8,091	4,130	6,009	10,138
50-54	2,591	4,615	7,206	2,140	5,512	7,653
55-59	2,170	3,902	6,072	2,198	4,517	6,715
60-64	1,294	2,428	3,722	1,881	3,803	5,684
65-69	1,203	2,102	3,305	1,106	2,363	3,469
70-74	920	1,607	2,527	1,017	1,958	2,975
75+	1,458	2,089	3,547	1,552	2,801	4,353
ALL AGES	78,408	88,009	166,416	83,244	95,826	179,070

AGE GROUP	2015 MALE	FEMALE	TOTAL	2020 MALE	FEMALE	TOTAL
0- 4	11,056	10,451	21,507	11,962	11,305	23,267
5- 9	10,578	9,660	20,237	9,732	9,226	18,958
10-14	8,414	7,694	16,108	10,777	9,511	20,288
15-19	10,295	8,720	19,015	8,268	7,274	15,542
20-24	8,346	7,508	15,854	10,846	8,846	19,691
25-29	8,117	8,603	16,721	9,168	8,401	17,568
30-34	7,461	7,048	14,509	6,659	9,380	16,040
35-39	4,563	7,284	11,847	7,264	7,076	14,340
40-44	5,794	6,775	12,568	3,822	6,934	10,756
45-49	2,769	6,150	8,919	4,404	6,464	10,868
50-54	3,559	5,880	9,439	2,311	6,135	8,446
55-59	1,868	5,369	7,237	3,019	5,755	8,774
60-64	1,883	4,390	6,273	1,619	5,233	6,852
65-69	1,585	3,528	5,113	1,609	4,272	5,881
70-74	876	2,077	2,953	1,340	3,286	4,626
75+	1,468	3,119	4,587	1,459	3,848	5,307
ALL AGES	88,632	104,256	192,888	94,259	112,946	207,204

TABLE VI.4 (d)
POPULATION PROJECTIONS, GUAM 1980-2020.

SERIES 4

AGE GROUP	1985 MALE	FEMALE	TOTAL	1990 MALE	FEMALE	TOTAL
0- 4	7,907	7,453	15,360	8,389	7,906	16,294
5- 9	6,595	6,364	12,959	7,842	7,387	15,229
10-14	6,424	6,161	12,586	6,571	6,346	12,917
15-19	5,775	5,486	11,261	6,390	6,149	12,539
20-24	5,779	5,124	10,903	5,717	5,469	11,186
25-29	5,950	5,070	11,020	5,710	5,104	10,814
30-34	5,134	5,108	10,241	5,881	5,050	10,932
35-39	4,783	4,405	9,189	5,074	5,086	10,159
40-44	3,309	2,828	6,138	4,713	4,376	9,089
45-49	2,557	2,354	4,911	3,235	2,797	6,031
50-54	2,053	1,955	4,007	2,467	2,311	4,778
55-59	2,042	1,656	3,698	1,941	1,893	3,834
60-64	1,424	1,180	2,605	1,863	1,572	3,435
65-69	834	807	1,641	1,241	1,089	2,330
70-74	561	573	1,134	690	709	1,399
75+	449	628	1,077	731	924	1,654
ALL AGES	61,576	57,154	118,730	68,455	64,167	132,622

AGE GROUP	1995 MALE	FEMALE	TOTAL	2000 MALE	FEMALE	TOTAL
0- 4	8,891	8,380	17,271	9,533	8,984	18,517
5- 9	8,357	7,883	16,241	8,818	8,306	17,124
10-14	7,801	7,372	15,173	8,326	7,861	16,187
15-19	6,503	6,327	12,830	7,760	7,357	15,117
20-24	6,314	6,125	12,439	6,437	6,307	12,744
25-29	5,651	5,448	11,099	6,239	6,101	12,340
30-34	5,644	5,082	10,726	5,586	5,428	11,014
35-39	5,796	5,017	10,812	5,578	5,060	10,638
40-44	4,959	5,029	9,988	5,711	4,983	10,694
45-49	4,548	4,295	8,842	4,847	4,973	9,820
50-54	3,059	2,709	5,767	4,388	4,215	8,603
55-59	2,251	2,193	4,444	2,892	2,624	5,516
60-64	1,692	1,746	3,438	2,053	2,082	4,135
65-69	1,541	1,381	2,923	1,475	1,610	3,085
70-74	955	905	1,860	1,275	1,213	2,489
75+	935	1,145	2,080	1,352	1,562	2,914
ALL AGES	74,896	71,038	145,933	82,269	78,667	160,936

TABLE VI.4 (d) CONTINUED
SERIES 4

AGE GROUP	2005 MALE	FEMALE	TOTAL	2010 MALE	FEMALE	TOTAL
0- 4	10,327	9,734	20,060	11,278	10,628	21,906
5- 9	9,497	8,959	18,456	10,242	9,648	19,890
10-14	8,772	8,289	17,061	9,461	8,933	18,395
15-19	8,241	7,837	16,078	8,726	8,272	16,998
20-24	7,667	7,328	14,995	8,157	7,813	15,970
25-29	6,363	6,283	12,646	7,576	7,300	14,876
30-34	6,166	6,075	12,241	6,290	6,259	12,549
35-39	5,504	5,391	10,896	6,094	6,048	12,143
40-44	5,452	5,004	10,456	5,424	5,355	10,780
45-49	5,510	4,891	10,401	5,329	4,948	10,277
50-54	4,583	4,817	9,400	5,317	4,800	10,116
55-59	4,003	4,001	8,004	4,334	4,665	8,999
60-64	2,521	2,420	4,941	3,652	3,797	7,450
65-69	1,699	1,829	3,528	2,197	2,231	4,429
70-74	1,135	1,339	2,474	1,406	1,607	3,013
75+	1,728	1,947	3,675	2,013	2,491	4,504
ALL AGES	89,168	86,143	175,311	97,495	94,797	192,292

AGE GROUP	2015 MALE	FEMALE	TOTAL	2020 MALE	FEMALE	TOTAL
0- 4	12,186	11,486	23,672	13,122	12,367	25,489
5- 9	11,235	10,599	21,834	12,086	11,385	23,471
10-14	10,188	9,628	19,816	11,193	10,569	21,762
15-19	9,365	8,906	18,271	10,135	9,608	19,743
20-24	8,621	8,240	16,862	9,269	8,878	18,148
25-29	8,063	7,783	15,846	8,518	8,208	16,727
30-34	7,487	7,268	14,756	7,970	7,754	15,724
35-39	6,198	6,217	12,416	7,400	7,237	14,637
40-44	5,956	5,981	11,938	6,108	6,176	12,284
45-49	5,233	5,256	10,489	5,822	5,915	11,737
50-54	5,039	4,793	9,831	5,049	5,158	10,208
55-59	4,850	4,556	9,406	4,765	4,642	9,406
60-64	3,778	4,302	8,080	4,425	4,324	8,750
65-69	3,022	3,336	6,358	3,293	3,968	7,260
70-74	1,690	1,856	3,546	2,500	2,931	5,431
75+	2,232	2,851	5,083	2,761	3,544	6,305
ALL AGES	105,145	103,059	208,204	114,418	112,664	227,081

TABLE VI.5
DEPENDENCY RATIOS, GUAM 1960-2020.
AGGREGATE POPULATION.

	1960	1970	1980	1990	2000	2010	2020
SERIES 1							
under 15	.7037	.6765	.5879	.4865	.4289	.3768	.3599
over 65	.0281	.0297	.0973	.0757	.1046	.1195	.1602
total	.7318	.7062	.6852	.5621	.5334	.4963	.5201
SERIES 2							
under 15	.7037	.6765	.5879	.4859	.4519	.4163	.4028
over 65	.0281	.0297	.0973	.0807	.1174	.1373	.1822
total	.7318	.7062	.6852	.5666	.5693	.5536	.5850
SERIES 3							
under 15	.7037	.6765	.5879	.5023	.4976	.4680	.4630
over 65	.0281	.0297	.0973	.0803	.1160	.1321	.1696
total	.7318	.7062	.6852	.5826	.6136	.6001	.6326
SERIES 4							
under 15	.7037	.6765	.5879	.5356	.5131	.4991	.5125
over 65	.0281	.0297	.0973	.0612	.0773	.0897	.1256
total	.7318	.7062	.6852	.5968	.5904	.5888	.6381

FIGURE VI.3 (a)

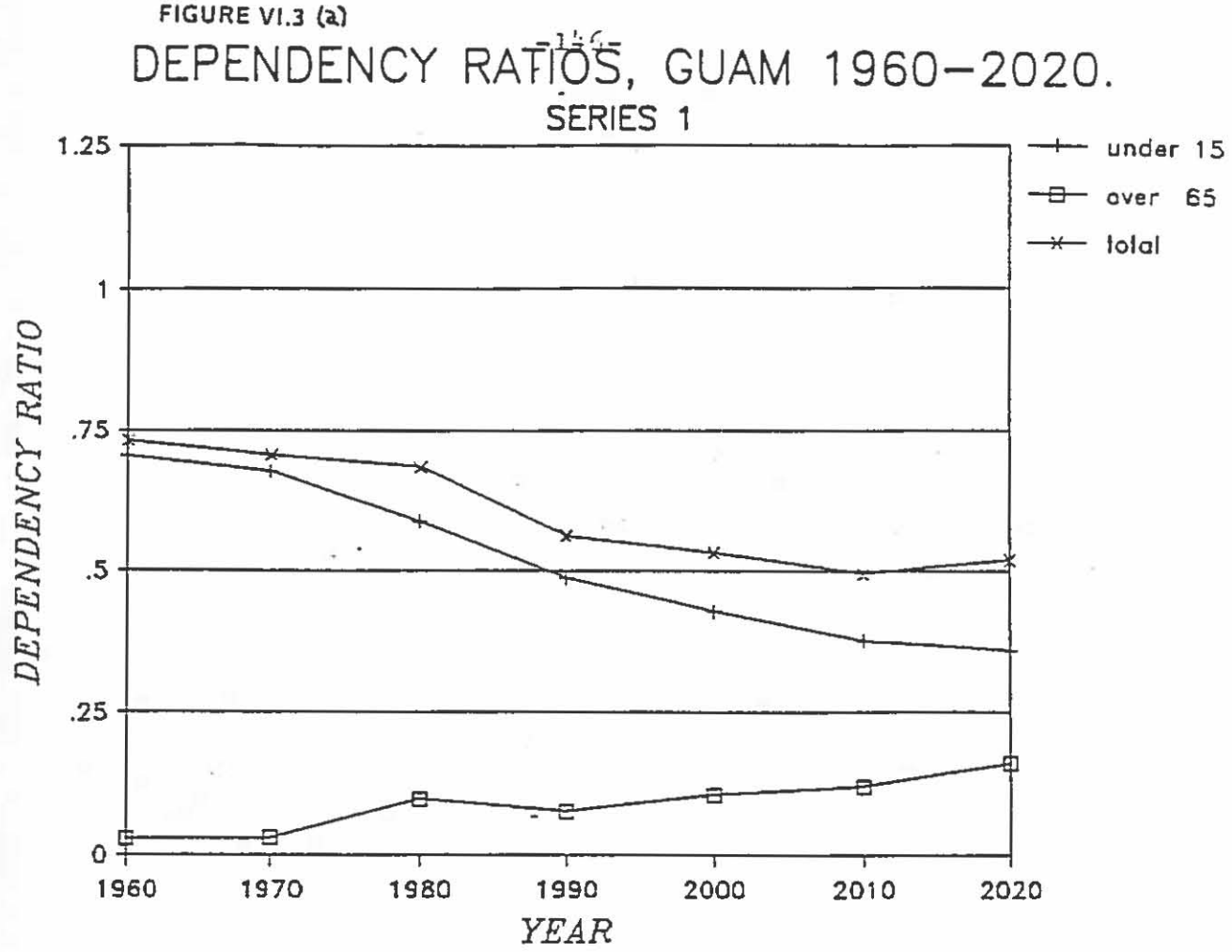
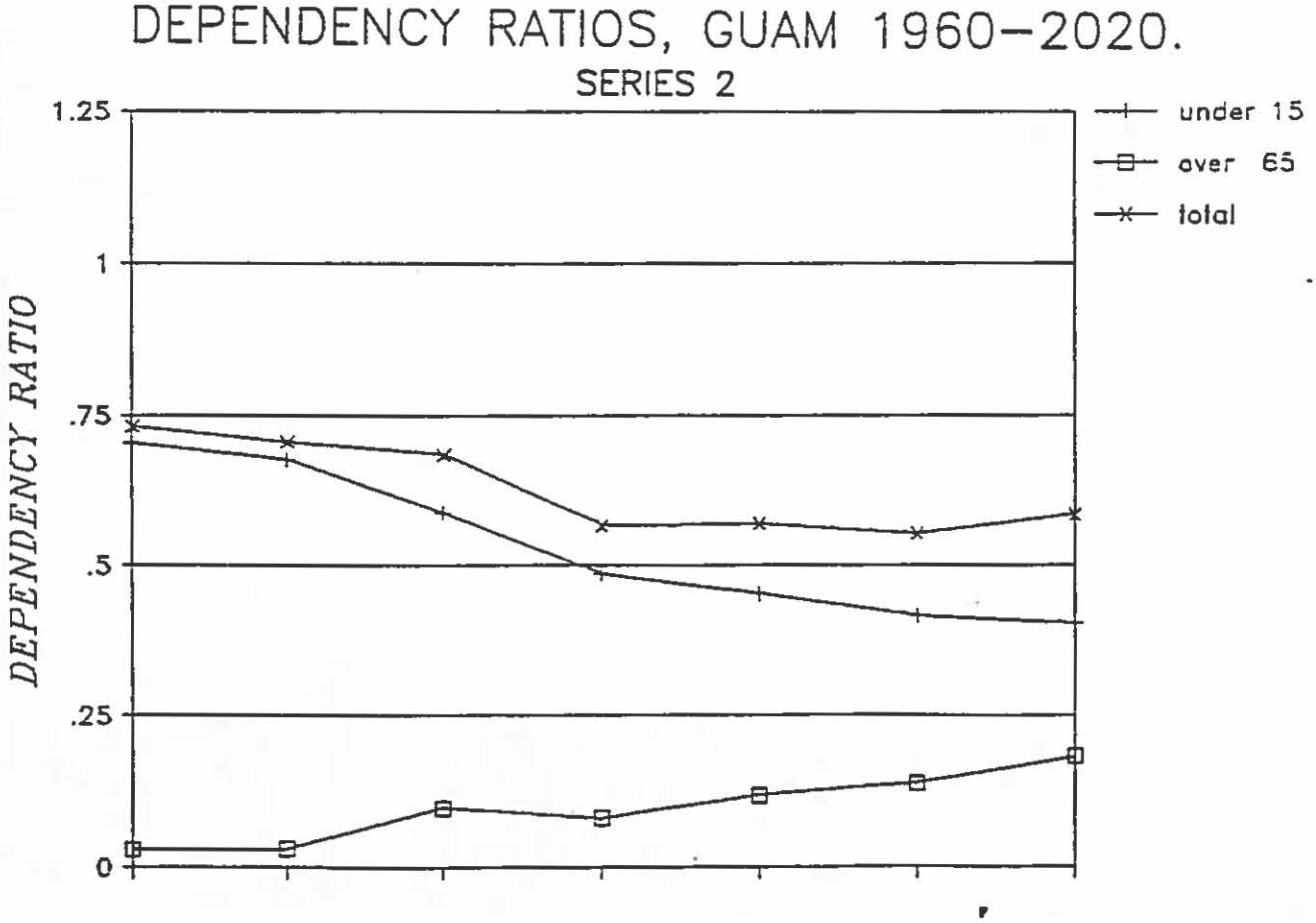


FIGURE VI.3 (b)



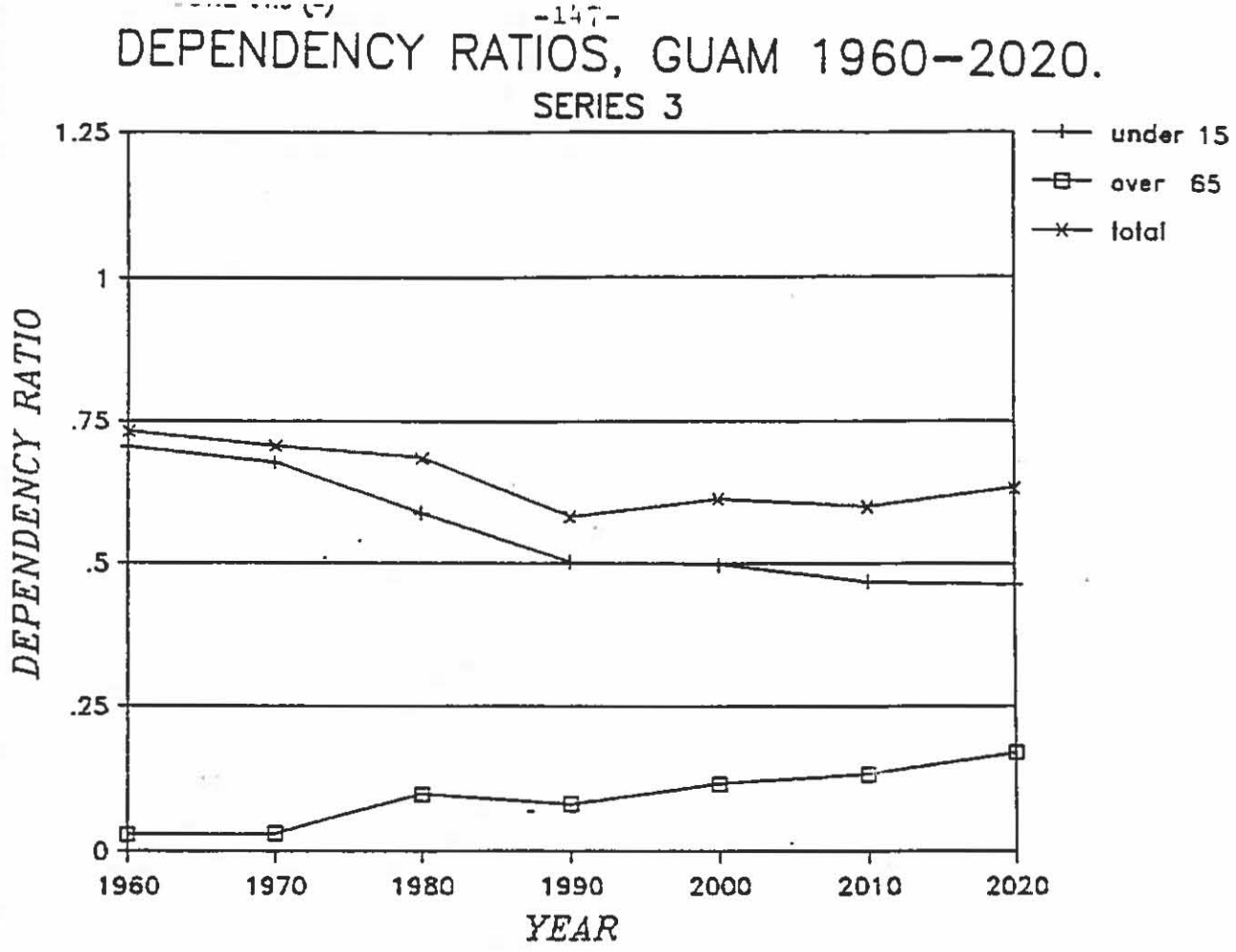
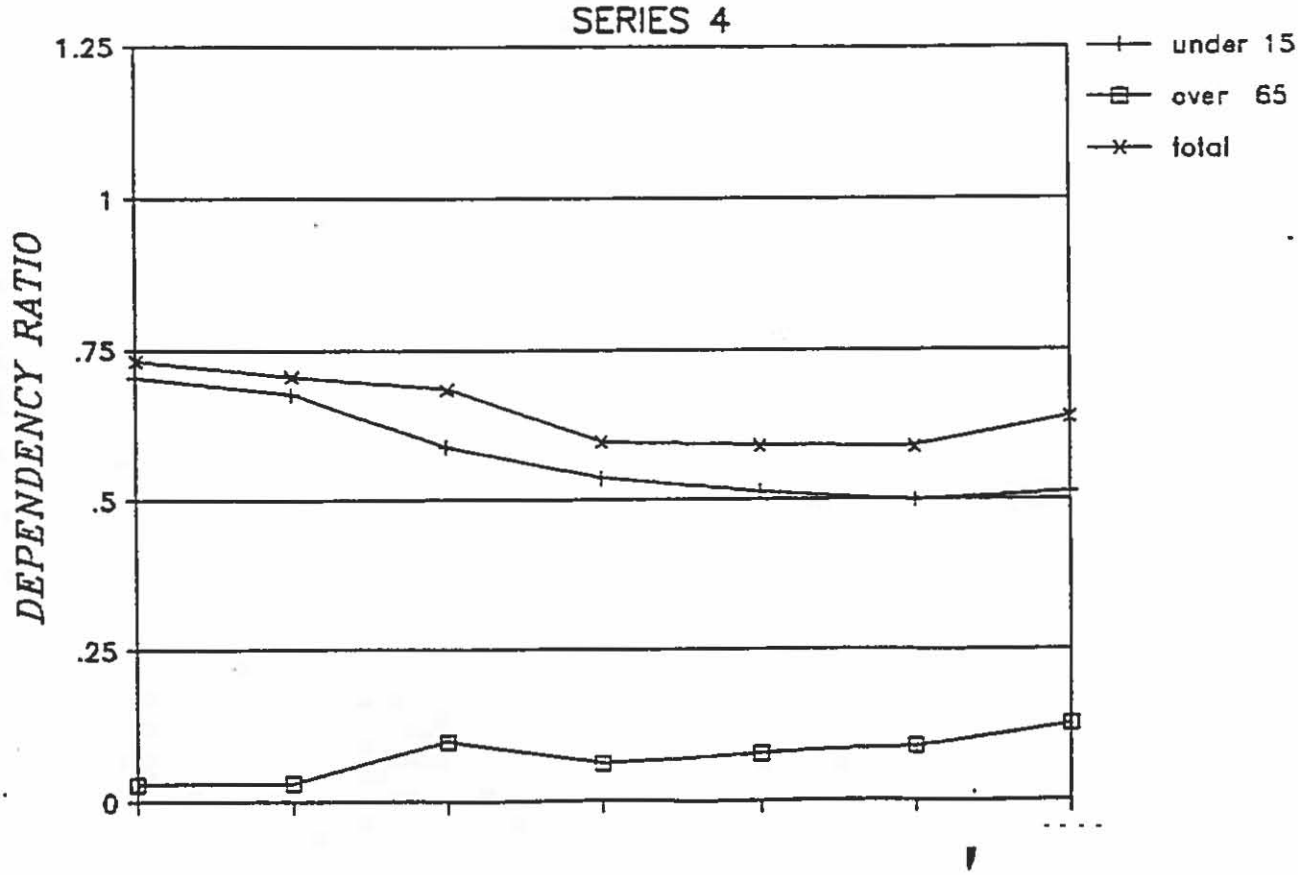

DEPENDENCY RATIOS, GUAM 1960–2020.
SERIES 3
under 15
over 65
total
1.25
1
.75
.5
.25
0
DEPENDENCY RATIO
1960
1970
1980
1990
2000
2010
2020
YEAR

FIGURE VI.3 (d)


DEPENDENCY RATIOS, GUAM 1960–2020.
SERIES 4
under 15
over 65
total
1.25
1
.75
.5
.25
0
DEPENDENCY RATIO

components that result in population change shows only moderate increase in total numbers. At the same time, however, the structure of the population becomes increasingly unbalanced, females outnumbering males in almost all age groups. As the Demographic Transition progresses the number and proportion of elderly people will increase substantially, while the school-age population will diminish in proportion, although not in numbers.

As a final remark it must be noted that these projections are made under the assumptions stated above and, like any other projection, assume that all other things remain equal. Since Guam has a relatively small total population and at present undergoes rapid development this final assumption may not hold true. To what extent these other developments may cause Guam's population parameters to develop along lines that will take them outside the projection boundaries no one can predict.

EPILOGUE - IMPLICATIONS AND RECOMMENDATIONS.

Separation of Guam's aggregate population into military and nonmilitary components, especially in census tabulations, appears to be one major issue that various government agencies on Guam agree upon. While such tabulation may have its use, the following points need be taken into consideration:

1) Since there is continuous interaction between military and nonmilitary, resulting in categories such as ex-military or part-time military, it is essential that before any data are gathered, based on the aforementioned distinction, well-defined criteria are developed to ensure the consistent use of this type of classification.

2) Subdivision of Guam's aggregate population according to criteria of ethnicity is not to be abandoned. It is the only way through which a historic perspective, useful for determining present and future trends, can be maintained. This consideration may be especially important to Guam's Chamorro population.

3) While classification according to criteria of military affiliation and ethnicity appears useful, their combination may result in aggravating problems of chance variation, due to low numbers in each category.

4) The ongoing dispute on the topic whether or not population projections should be done on the basis of the civilian or the aggregate population can be resolved by taking the migration component into regard. As in the present report, the "replacement process" among Guam's military population can be simulated using Age Specific Net Migration Rates.

The only two agencies that presently generate basic demographic data for Guam, the U.S. Bureau of the Census in conjunction with its field division, the Census & Population Division of the Guam Department of Commerce and the Office of Vital Statistics of the Guam Department of Public Health and Social Services both can improve the relevance of their data for demographic analysis. Based on the most recent publications of these agencies the following modifications of existing tabulation procedures are recommended;

as far as Vital Statistics is concerned:

1) Tabulate births by ethnicity and age (of the mother) and sex of the child. Age needs to be classified in five-year age groups, spanning the range 15-49 years. For the sake of completeness terminal categories <15 and >50 may be included.

2) Tabulate deaths by ethnicity, age and sex. The variable "age" needs to be classified in five-year age groups with a subdivision for the youngest group into "<1" and "1-4". The present tabulation of these three variables does not represent a true "three-way" cross-tabulation.

as far as the Census is concerned:

1) Tabulate ethnicity by sex and age up to at least 75 years. Age needs to be classified in five-year age groups, the youngest group divided into "<1" and "1-4".

2) Tabulate fertility variables, i.e. Children Ever Born, Children Surviving and Children Born Last Year by five-year age groups of the mothers and sex of the child.

3) Tabulate fertility variables as in (2) by ethnicity of the mother.

4) Tabulate Place of Enumeration by Place of Residence 5 years prior to the census for districts of Guam.

It must be mentioned that the topics on which data were gathered in the 1980 census represent a major improvement over the census of 1970. In this respect the census is, for the present purposes at least, quite satisfactory. The following suggestions on data gathering might be considered, however:

5) Although the topic has not been dealt with in the present study, adoption is known to be significant on Guam. Response to the present set of fertility questions might improve with an additional question on this topic.

6) The observed selective underreporting of those Children Ever Born who have died, and the resulting relative overreporting of the variable Children Surviving may be improved by special instructions to the enumerators and/or rephrasing of the question; i.e. avoiding the term "stillbirths".

7) Of much concern is the problem of a ten-year interval between successive censuses. Population change, especially on Guam, is happening so rapidly that censuses need to take place, for example, every five years. Regarding the fact that a quinquennial census had already been planned for 1985, but had to be abandoned because of budget restraints, it can only be hoped that in 1995 this badly needed addition will come through.

The present study clearly indicates that the major components in the process of population change on Guam are fertility and migration. Both components exert such pronounced influence that closer monitoring of their dynamics must be regarded of great importance. Concerning the fertility component a sample survey would be the appropriate tool to use for further investigation. The experience

gathered in the World Fertility Survey can be used to employ well-tested questionnaires and frameworks for analysis. This would also be beneficial for purposes of international comparison.

The component of migration appears to be the most problematic. Although it has received much attention in the 1980 census certain aspects, such as average duration of stay on Guam or purpose of migration remain obscure. As noted before, no separate data on this topic have been gathered. A survey could do well in gathering information that would be required to gain more insight in the dynamics of this process. Experience gained in migration surveys conducted by ESCAP may prove valuable in this regard. Special attention needs to be given to the average duration of stay among various population subgroups.

Continuous monitoring of migration would be the ideal way of gaining insight into the various migration patterns. The possibility that the required administrative structure will ever be established on Guam is remote, however. As long as Guam is part of the U.S.A. it will not be able to enforce the legislation needed for such an administrative structure.

Attention is drawn to the possible utilization of the existing procedure for arriving passengers to fill out a form upon arrival. At present this information is collected through the customs officers for the Department of Commerce, of which customs is a division. The form that is presently being used is ill-suited for the purpose of obtaining reliable and complete basic demographic data from migrants, however. As this procedure must take place on a voluntary basis, the forms need to be basic, simple and quick to fill out. It is also unfortunate that no such procedure exists for departing passengers. Such an addition, which would provide Guam with an unique insight into characteristics of its migrants, is worth pursuing.

As a final remark it must be mentioned that no additional data gathering efforts or cross-tabulations of existing data will by themselves be sufficient: only after processing and evaluation can any additional demographic data be converted into information and put to use.

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