DEMOGRAPHIC CHANGE IN KOSRAE STATE, FEDERATED STATES OF MICRONESIA

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The population of Kosrae has changed dramatically since its first contact with non-Micronesian societies nearly two hundred years ago. Some of the greatest changes occurred during the nineteenth century, when diseases introduced by outsiders nearly eradicated the native population. More recently the number of Kosrae residents has grown, the rapid increases during the twentieth century producing populations larger than any previously documented. The following study examines the evolving demography of this small archipelago. It begins with a summary of key periods of Kosrae history, followed by a description of demographic change based on available census data. Possible causes of population change are examined, focusing on fertility, mortality, and mobility. The study concludes with a discussion of the sociocultural and ecological impacts of demographic change in Kosrae and their implications for the future of this portion of the Federated States of Micronesia.

Introduction

The arrival of European explorers in Micronesia nearly five centuries ago opened the way for many changes in this portion of Oceania. One of the most important was demographic change. Although the particulars varied between islands, a basic pattern persisted throughout most of the region: an initial period of depopulation, usually due to diseases introduced by explorers, whalers, and missionaries from outside Micronesia; and a subsequent period of population growth, usually resulting from improved health care and frequently leading to modern populations larger than any known in the past (see Taeuber 1963; Gorenflo and

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Levin 1992b, 1992c). The precise nature of these changes often varied. In Kosrae State in the Federated States of Micronesia (FSM), depopulation was particularly severe--nearly eradicating native inhabitants during the nineteenth century (Ritter 1981b:22-24).[1] Sustained demographic growth followed throughout most of the twentieth century, producing a population in 1986 greater than any previously documented.

The following study, the third in a series that explores population change in the FSM, focuses on the demography of Kosrae State. The essay begins by reviewing the roles of non-Micronesian societies in Kosrae, with an emphasis on how their activities affected the number and distribution of island inhabitants. It then examines available demographic data, emphasizing information collected by seventeen censuses of Kosrae between 1855 and 1986. Through analyzing available data on fertility, mortality, and migration, the study explores mechanisms underlying documented population changes. Finally, it considers repercussions of population change in Kosrae--including impacts on subsistence activities, the maintenance of social institutions, and economic strategies--in an effort to characterize past and present adaptive challenges faced in this portion of the FSM.

Non-Micronesian Societies and Their Impacts on the Demography of Kosrae

Kosrae State lies at 5° 19' north latitude, 163° 0' east longitude in the Eastern Caroline Islands (Bryan 1971). Technically the state comprises an archipelago of fifteen islands within a fringing reef, though historically people lived on only two of the islands--Ualang and Lelu (Shinn 1984:325; Figure 1). Ualang, by far the largest island in the archipelago, is volcanic in origin and features an extremely rugged interior (Lewis 1949: 1; Peoples 1985:28; Soil Conservation Service 1983: 1-2). Lelu Island, lying in a bay about 1,600 feet from the northeastern coast of Ualang (Morgan 1988:89), is much smaller and less rugged than its large neighbor. Due in part to its geographic location and in part to its physiography, Kosrae receives particularly large amounts of rain--the approximately 250 inches falling annually along the main island's west coast probably exceeded by rainfall in its interior (Krebs 1904; Office of the Chief of Naval Operations 1944:5; Wilson 1968:18). The combination of high annual rainfall and rich volcanic soil has resulted in dense vegetation throughout most of the archipelago.

Early colonists from the Marshall Islands or Kiribati probably settled

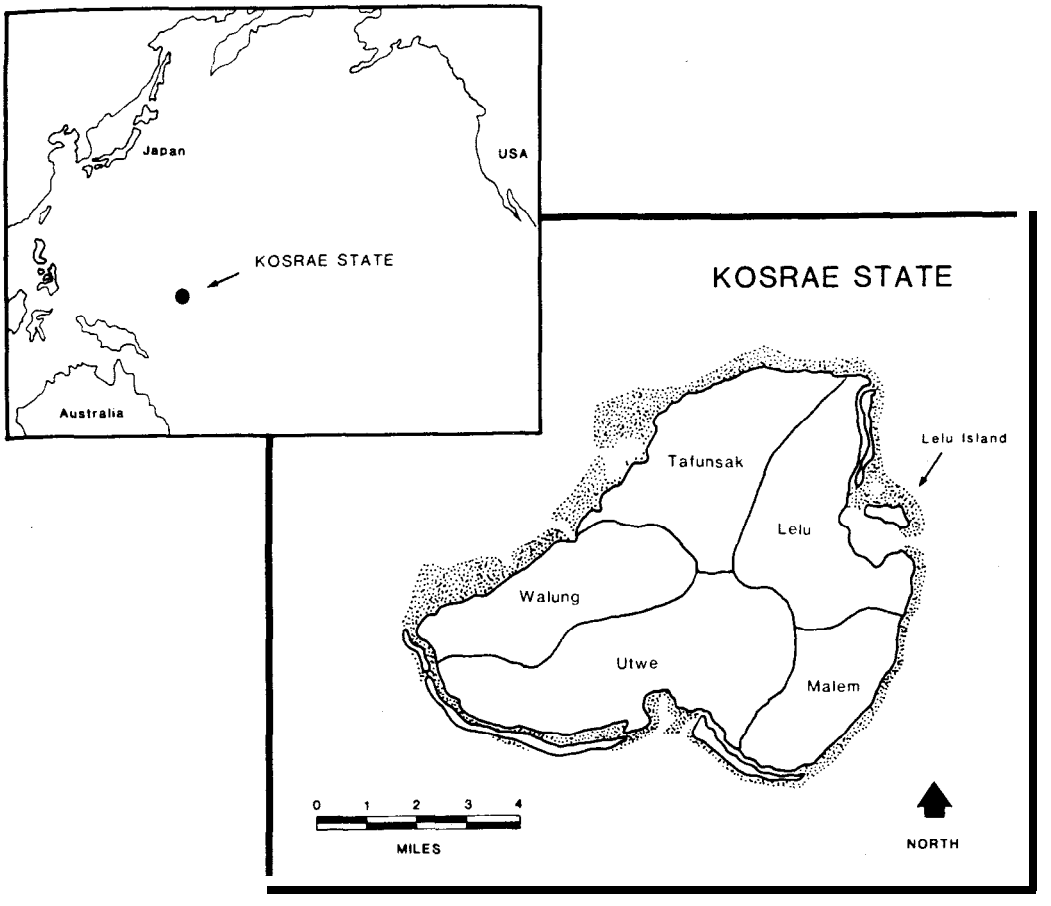


FIGURE 1. **Kosrae State.**

Kosrae sometime after 1000 B.C. (Hezel 1983:3), though sparse evidence throughout the Carolines limits our understanding of the earliest phases of habitation (Campbell 1989:36). Although the Spanish explorer Saavedra possibly sighted Kosrae in 1529 (Sarfert 1919:1; Office of the Chief of Naval Operations 1944:17; Lewis 1949:26), the first certain sighting by non-Micronesians was by the American ship *Hope* in 1801 (Hezel 1983:84). Three years later another American vessel, the *Nancy*, also sighted Kosrae, the captain naming it Strong's Island after the governor of Massachusetts (Finsch 1893:194). Europeans did not actually set foot on Kosrae until June 1824, when a French scientific team aboard the corvette *Coquille* visited for ten days (see Duperrey 1828; Dumont d'Urville 1834; Lesson 1839). The natives' unfamiliarity with white men and iron suggests that the French were the first non-Micronesians to visit the island (see Lesson 1839, 2:459-514). In late 1827 the Russian explorer Lütke also visited Kosrae, staying for roughly three weeks (Lütke 1835, 2:299-410). Early European visitors marveled

at the native culture on Lelu Island, noting both the highly centralized political system there (Hezel 1983:111; Kiste 1984:22) and the complex of stone-walled compounds on the western portion of the small island that housed Kosraen nobility (Lesson 1839, 2:494; Cordy 1982; Morgan 1988:86-98). Lütke attempted to obtain a count of all adults in Kosrae in 1827, arriving at a total of 800 (1835, 1:343-345). Unfortunately, he apparently missed fourteen traditional districts (Sarfert 1919:49). Most who have studied the topic generally conclude that Lütke's estimate was too low and, in the absence of other systematic attempts to count inhabitants, estimate that between 2,000 and 6,000 persons resided in Kosrae at European contact (see *Missionary Herald* 1897:305; *Missionary Herald* 1899:10; Sarfert 1919:49; Wilson 1968:21; Ritter 1981b), with as many as 1,500 on Lelu Island (Morgan 1988:89). The Europeans apparently arrived shortly after a period of dramatic depopulation caused by a particularly destructive typhoon and subsequent political unrest, which may have reduced the resident population by as much as 50 percent early in the nineteenth century (Gulick 1932:503; Ritter 1978:44-47; Ritter 1981b:24-25; Morgan 1988:90, 98).[2]

Kosrae quickly became a popular stop for whalers during the 1830s, providing safe harbors, wood, fresh water, and hospitality (Office of the Chief of Naval Operations 1944:18, 22). By 1835, roughly thirty runaways from these ships resided in Kosrae (Hezel 1983:113). Unfortunately, a dispute erupted that same year when the crew of the Hawaiian brig *Waverly* took several Kosraen women aboard against their will; in response, the islanders attacked and killed all but a few of the crew members (Wilson 1968:20; Ritter 1978:25; Hezel 1983:113-114). Mistrust and uneasiness followed, and the islanders attacked two other ships over the next nine years--eventually prompting the paramount chief to end beachcombing in Kosrae in 1844 and to limit, with infrequent exceptions, the visits of whites to a few weeks (see Lewis 1949:28, 52; Fischer and Fischer 1957:36; Hezel 1983:117-118). This decision by the chief, coupled with the decline of whaling in the central Pacific by the mid-1850s and a further ban on whites following an uprising in 1857 (Lewis 1949:34), largely served to isolate Kosrae from the outside world. Despite occasional visits for supplies, the only whites who resided on Kosrae for several years during the mid-nineteenth century were the American missionary Benjamin Snow and his wife, who lived there between 1852 and 1862 (Office of the Chief of Naval Operations 1944:18; Wilson 1968:20; Brown 1977:137; Hezel 1983:143).

The isolation of Kosrae came too late to protect the native residents from the ravages of diseases introduced by some of the early non-

Micronesian visitors. Although no postcontact depopulation is evident before 1848 (Ritter 1978:48), once diseases became established, they took a frightening toll. For example, between 1828 and 1874 the population of Kosrae decreased from roughly 3,000 persons to about 400 (Ritter 1981b:21; *Missionary Herald* 1875:136). The culprits were several: influenza and respiratory diseases, documented by Snow (see Lewis 1949:50), were the major causes of death during these years; gonorrhea, in turn, probably caused much sterility in women (Ritter 1978: 63-64). Two typhoons also struck Kosrae during the mid-nineteenth century, one in 1837 and another in 1852 (Wilson 1968:18), but their demographic impacts apparently were minimal. The few people who relocated permanently to Kosrae during this period did little to counter the severe depopulation that occurred between the 1840s and the 1880s. By 1880 Kosrae population had fallen to about 300 persons (Ritter 1978:55).[3]

Although many of the most important impacts on Kosrae occurred during efforts by another nation to colonize it, the Spanish administration provides a notable exception. Spanish ships were the first from Europe to visit Micronesia in the early sixteenth century, claiming the islands in the region as part of Spain's growing global empire. But Spain paid little attention to most islands in Oceania for more than three centuries. Even in the face of challenges to its sovereignty by other nations, the Spanish presence in the Eastern Caroline Islands never amounted to more than the establishment in 1887 of a small governmental station on Pohnpei, from which officials made brief visits to other islands in the area (Office of the Chief of Naval Operations 1944:19; Fischer and Fischer 1957:36-37; Wilson 1968:21). A strong typhoon struck Kosrae during the Spanish administration in 1891, destroying six houses and crops and killing an unknown number of people (Office of the Chief of Naval Operations 1944:6; Wilson 1968: 18). Depopulation had stopped sometime near the end of the nineteenth century, most likely owing to growing natural immunity to some diseases and increased isolation from others (Lewis 1949:57). The limited presence of the Spanish in Kosrae had no known effect on the population.

Germany competed with Spain for control of Micronesia during most of the late nineteenth century, pursuing mainly commercial ventures. Although frustrated in an attempt to annex several main islands throughout Micronesia in the mid-1880s (Hezel 1983:308-312; Shinn 1984:326), Germans successfully established a branch of the Jaluit Trading Company in Kosrae in 1887 with little opposition from Spain (Office of the Chief of Naval Operations 1944:23-24). Germany even-

tually purchased the Caroline and Marshall islands from Spain in 1899, following Spain's defeat in the Spanish-American War (Fischer and Fischer 1957:47; Brown 1977). Although Germany established a definite presence on several islands throughout Micronesia, in an attempt to develop the area commercially, it paid little attention to Kosrae. With the exception of planting some coconut groves to help meet increasing market demands for copra, the major German impact on Kosrae was religious--actively promoting a revival in Christianity that had waned over the previous few decades (Fischer and Fischer 1957:48-49; Ritter 1978:30-31; Peoples 1985:54-55). Demographic impacts of Germany's administration consisted of a few German missionaries in residence; no German administrators resided permanently in Kosrae (Ritter 1978:31). Another major typhoon struck Kosrae in 1905, once more causing widespread destruction as well as killing five islanders (Office of the Chief of Naval Operations 1944:6; Lewis 1949:51; Peoples 1985:30). Nevertheless, the period of depopulation clearly was past, and the number of Kosrae residents had begun a long period of growth.

When Germany entered World War I, Japan occupied its Micronesian possessions (the Caroline, Northern Mariana, and Marshall islands), with a Japanese squadron anchoring off Kosrae in October 1914 (Peattie 1988:43) and an army detachment of fifty enlisted men and three officers landing shortly thereafter (Lewis 1949:43). The League of Nations officially recognized Japanese administration of the area in 1920, when it granted Japan a Class C Mandate (Clyde [1935] 1967; Peattie 1988:56-59). Japanese interest in Kosrae had both commercial and military motives, the latter eventually becoming preeminent. Prior to the war effort, Japan showed little interest in Kosrae. Early in the Japanese administration only one Japanese national (an army sergeant) resided in the archipelago (Lewis 1949:44; Ritter 1978: 32-33), and with the exception of small agricultural and timber operations, the new administration made little effort to develop Kosrae economically (see Office of the Chief of Naval Operations 1944:135). In 1922 Japan constructed a branch public hospital on Kosrae (Office of the Chief of Naval Operations 1944:97; Peattie 1988:87), and eventually a small community of Japanese (numbering fewer than 100 persons and consisting mostly of Okinawan fishermen and traders) became established on Lelu Island (Peattie 1988: 184). Development increased during the 1930s. In part this increase was due to the cash income received from increased copra production, as coconut groves planted during German times reached their productive apex, and in part it was due to Japanese-sponsored efforts to produce materials such as rope needed by the military (Peoples 1985:55).

Although strategically located, Kosrae did not figure greatly in Japan's war effort. Despite good harbors and a rugged, defensible interior on the main island, there was no good location for an airfield (Peattie 1988:231-232). Beginning in 1938 and continuing into the 1940s, the military buildup of Kosrae increased markedly (Ritter 1978:33). Japanese military leaders moved their own personnel as well as people from other parts of the Pacific (Ocean Island, Korea, Okinawa, and elsewhere in the Mandated Territory) to Kosrae (Peoples 1985:56-57), promoting agricultural development in the hope of establishing a supply point for Japanese forces stationed in the Marshall Islands. After allied forces cut off supply lines, much of the war bypassed Kosrae--with the exception of occasional bombing raids to ensure its neutralization. Although these raids killed some islanders (Wilson 1968:35; Ritter 1978: 33), most fled inland from the coast and probably escaped the brunt of the bombing. As the war's end approached, famine ensued in Kosrae, leading to the death of 300 to 700 resident Japanese soldiers and untold numbers of Kosraens (Wilson 1968:36; Peattie 1988:304). Prior to the war, the Micronesian population of Kosrae had grown steadily during the Japanese administration, with the number of resident Pacific Islanders increasing by more than 51.0 percent between 1920 and 1935 (see Nan'yō-chō 1937).

The United States began to administer Kosrae and other islands throughout Micronesia following the Japanese surrender in August 1945. In 1947 Kosrae became part of the Trust Territory of the Pacific Islands (TTPI), a strategic area established by the United Nations with the United States as "administering authority" (Shinn 1984:303-305; Peoples 1985:9). In part because of political subordination to Pohnpei in the Trust Territory organization and in part because it contained fewer than 2,000 inhabitants, Kosrae received limited attention during the decades immediately following the war (Peoples 1985:59-60). Even wartime destruction largely went unrepaired. As a result, the population reverted to subsistence agriculture (Lewis 1949:68-69), and the Kosraen standard of living dropped to the levels experienced before the Japanese administration. In the early 1960s the United States began sending increased funds to support development in Kosrae, enabling improvements in infrastructure and services (Peoples 1985:61-63). After years of separatist movements (Wilson 1968:29; Mason 1974:258-260), Kosrae split from Pohnpei District in 1977 and became a separate entity within the TTPI (Shinn 1984:325). Throughout the period of the American administration, the population of Kosrae grew rapidly--generally at an average rate in excess of 3.0 percent annually.

In May 1979 Kosrae and three other Caroline districts of the TTPI

(Chuuk, Pohnpei, and Yap) approved a constitution and became a self-governing nation, the Federated States of Micronesia. A Compact of Free Association, signed into law in November 1986, defined future relations between the FSM and the United States. For the first fifteen years of the compact, the United States is to provide funds and development assistance with the intention of helping the FSM achieve economic and political independence (Shinn 1984:308-311). During Kosrae State's first six years as part of the FSM, its population continued to grow at an average annual rate in excess of 3.0 percent.

Changing Demography in Kosrae

The population of Kosrae has changed substantially since the arrival of Europeans in the early nineteenth century. Previous research on Kosrae demography identified two phases of postcontact demographic history: the period between European contact and 1880, when the archipelago experienced massive depopulation, and the period between 1880 and 1973, characterized by rapid population growth (Ritter 1978:36). Data from the two most recent censuses indicate a continuation of the latter trend through 1986.

In all, Kosrae has been the subject of seventeen censuses conducted over the past 140 years: five by American missionaries living on (or visiting) Lelu between 1855 and 1874 (American Board of Commissioners for Foreign Missions 1856; *Missionary Herald* 1857, 1859, 1860, 1875); one by the German government in 1905 (Sarfert 1919:49); four by the Japanese Nan'yō-chō (South Seas Bureau) between 1920 and 1935 (Nan'yo-cho 1927, 1931, 1937); one by the U.S. Navy in 1947 (Lewis 1949:48); two by the TTPI administration, in 1958 and 1973 (Office of the High Commissioner 1959; Office of Census Coordinator 1975); one by the University of Hawaii School of Public Health, in collaboration with the Peace Corps, in 1967 (School of Public Health n.d.); two by the U.S. Bureau of the Census as part of their decennial census efforts in 1970 and 1980 (U.S. Bureau of the Census 1972, 1983a); and one by the FSM Office of Planning and Statistics in 1986 (Office of Planning and Statistics 1989). Table 1 presents the final counts recorded in the seventeen censuses of Kosrae, in addition to several population estimates made prior to or between censuses. The two contrasting trends in Kosrae's demographic history are evident in these data, as they are in a graph of population change over time (Figure 2).

In addition to recording total residents of Kosrae, the most recent censuses also recorded the municipality of residence for de facto popula-

TABLE 1. **Population of Kosrae by Year, Showing Population Change Between Census Years: Select Years**

Year	Population	Change from Previous Listed Census Year	Average Annual Change from Previous Listed Census Year	Source
1824	2,000	. . .	. . .	Duperrey 1828
1824	1,200	. . .	. . .	Lesson 1839
1824	2,000-3,000		. . .	Dumont d'Urville 1834
1843	2,000	. . .	. . .	Ward 1967
1850	1,500	. . .	. . .	*The Friend* 1850
1853	1,300	. . .	. . .	Hammet 1854
1855	**1,106**	**. . .**	**. . .**	**American Board of Comm. for Foreign Missions 1856**
1856	**975**	**-131**	**-11.8%**	***Missionary Herald* 1857**
1857	**830**	**-145**	**-14.9%**	***Missionary Herald* 1859**
1858	**748**	**-82**	**-9.9%**	***Missionary Herald* 1860; Damon 1861**
1862	600		. . .	American Board of Comm. for Foreign Missions 1863
1868	500	. . .	. . .	*Missionary Herald* 1868
1872	300	. . .	. . .	*Missionary Herald* 1873
1874	**397**	**-351**	**-3.9%**	***Missionary Herald* 1875**
1880	200	. . .	. . .	Finsch 1893
1888	350	. . .	. . .	Finsch 1893
1890	80	. . .	. . .	Finsch 1893
1895	400	. . .	. . .	Christian 1899
1899	450	. . .	. . .	Lewis 1949
1905	**516**	**119**	**0.8%**	**Sarfert 1919**
1913	612	. . .	. . .	Lewis 1949
1920	**786**	**270**	**2.8%**	**Nan'yo-cho 1937**
1925	**886**	**100**	**2.4%**	**Nan'yo-cho 1927**
1930	**990**	**104**	**2.2%**	**Nan'yo-cho 1931**
1935	**1,189**	**199**	**3.7%**	**Nan'yo-cho 1937**
1947	**1,701**	**512**	**3.0%**	**Lewis 1949**
1949	1,775	. . .	. . .	U.S. Dept. of the Navy 1949
1951	1,952	. . .	. . .	U.S. Dept. of the Navy 1951

TABLE 1. **Continued**

Year	Population	Change from Previous Listed Census Year	Average Annual Change from Previous Listed Census Year	Source
1952	2,060	. . .	. . .	U.S. Dept. of Interior 1952
1954	2,114	. . .	. . .	U.S. Dept. of State 1955
1958	**2,367**	**666**	**3.0%**	**Office of the High Commissioner 1959**
1960	2,761	. . .	. . .	U.S. Dept. of State 1961
1962	3,019	. . .	. . .	U.S. Dept. of State 1963
1965	3,351	. . .	. . .	U.S. Dept of State 1966
1967	**3,260**	**893**	**3.6%**	**School of Public Health n.d.**
1968	3,542	. . .	. . .	U.S. Dept. of State 1969
1969	3,648	. . .	. . .	U.S. Dept. of State 1970
1970	**3,266**	**6**	**0.1%**	**U.S. Bureau of the Census 1972**
1971	3,854	. . .	. . .	U.S. Dept. of State 1972
1972	4,614	. . .	. . .	U.S. Dept. of State 1973
1973	**3,989**	**723**	**6.9%**	**Office of Census Coordinator 1975**
1975	4,190	. . .	. . .	U.S. Dept. of State 1978
1976	4,330	. . .	. . .	U.S. Dept. of State 1978
1978	4,610	. . .	. . .	U.S. Dept. of State 1979
1980	**5,491**	**1,502**	**4.7%**	**U.S. Bureau of the Census 1983a**
1984	6,262	. . .	. . .	U.S. Dept. of State 1985
1986	**6,607**	**1,116**	**3.1%**	**Office of Planning and Statistics 1989**

Notes: Census years in **boldface.** 1920-1935 data are for Pacific Islanders only. All census data reported are de facto population. Intercensal estimates after 1947 are *de jure* population; intercensal estimates before 1920 are de facto population. For all tables, "-" denotes zero or a percentage that rounds to less than 0.1; "NA" = not available; ". . ." = not applicable.

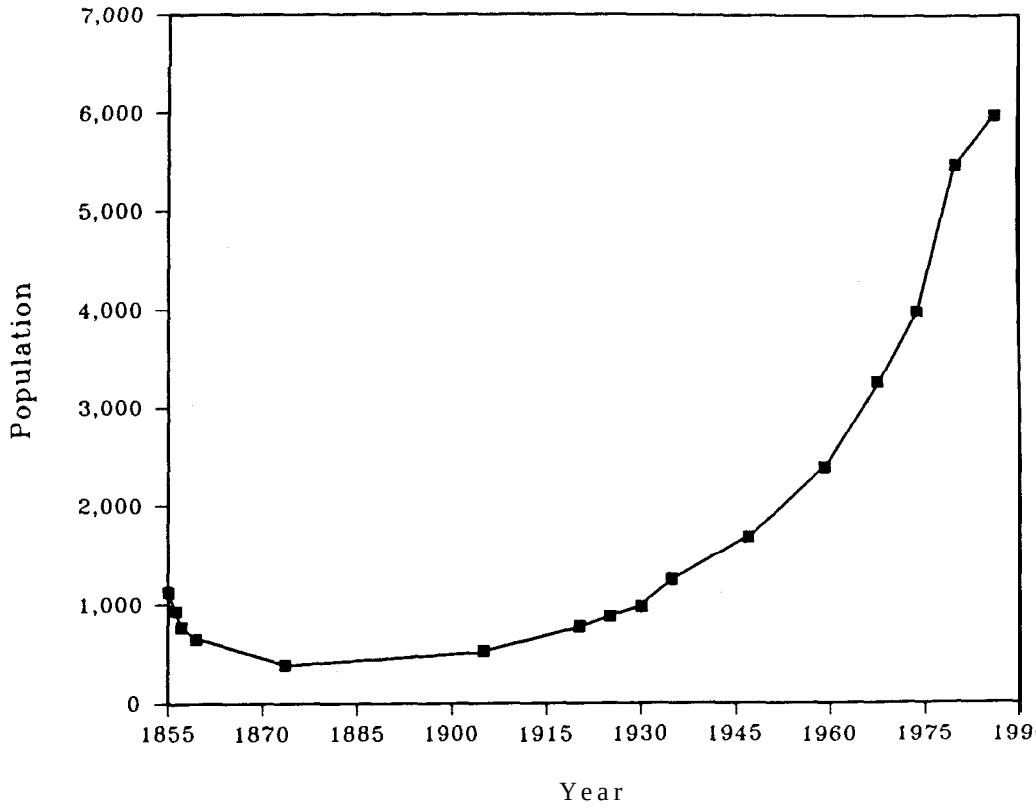


FIGURE 2. **Change in the population of Kosrae over time (1855, 1856, 1857, and 1858 are Kosraens only; 1920, 1925, 1930, and 1935 are Pacific Islanders only).**

tion. Because the economic and logistical challenges associated with regional arrangement of population in Kosrae are minimal compared to the challenges faced by polities composed of many islands scattered across the Pacific, I do not examine the geographic distribution of people in as much detail here as in other research settings (see Gorenflo 1990, 1993; Gorenflo and Levin 1991, 1992b, 1992c). However, consistency in the spatial arrangement of population in Kosrae over time bears mentioning (Table 2). Although slight shifts in the population density of one municipality compared to another occurred over the past seventy years, the general stability found in population figures persists here as well (Table 3). The eightfold increase in density on Ualang and Lelu islands in the twentieth century is similar in magnitude to changes experienced on the Yap Islands during the same time period (Gorenflo and Levin 1991:107).

To explore population change in Kosrae State more carefully, I examine the census data in nine separate sections: one for the missionary period, when the population of Kosrae declined dramatically; one for

TABLE 2. **Population by Municipality: Select Census Years**

Area	1925	1930	1935	1967	1970	1973	1980	1986
Kosrae	886	990	1,189	3,260	3,266	3,989	5,491	6,607
Lelu	312	346	430	1,040	1,650	1,385	1,995	2,422
Malem	186	215	244	701	562	788	1,091	1,354
Tafunsak	271	304	365	777	555	981	1,342	1,568
Utwe	117	125	150	558	499	698	912	1,076
Walung	NA	NA	NA	NA	NA	137	151	187

Sources: Nan'yō-chō 1927, 1931, 1937; School of Public Health n.d.; U.S. Bureau of the Census 1972, 1983a; Office of Census Coordinator 1975; Office of Planning and Statistics 1989.

Notes: Censuses conducted in 1855, 1856, 1857, 1858, 1874, 1905, 1920, and 1958 did not report population by municipality. Data for 1925-1935 comprise de facto Pacific Islanders only. Remaining data are de facto population. 1967 total includes 184 persons whose municipality of residence was "not specified." Population figures for Tafunsak Municipality in 1925-1970 include the population of Walung. Wilson (1968) conducted two censuses of Lelu Island (which is not equivalent to Lelu Municipality, the latter also containing part of Ualang Island around Lelu Harbor), recording 978 residents in early 1961 and 1,206 residents in the summer of 1964.

the German period, when population had begun its resurgence; one for the Japanese period, characterized by sustained population growth documented by four separate censuses; and one section each for the censuses conducted in 1947, 1958, 1967, 1973, 1980, and 1986, all marked by rapid population growth. Because the 1970 census of the TTPI was inaccurate, reflecting a substantial undercount, particularly in Kosrae, I shall not discuss its results in any detail. The following presentation focuses on essential data, noting important aspects of population change and drawing attention to possible causes where appropriate.

Kosrae Population during the Missionary Period: 1855, 1856, 1857, 1858, and 1874

Missionary Benjamin Snow arrived on Lelu Island early in the period of massive depopulation that affected Kosrae during much of the mid-nineteenth century. With the prospect of his new flock's dying off no doubt a major concern, Snow conducted a series of five censuses to document the population decline he witnessed. The first four of these censuses spanned the years 1855 through 1858, when Snow resided in Kosrae; Snow conducted his final census in 1874 while visiting Kosrae from the post he then occupied in the Marshall Islands (Lewis 1949: 37).[4] It is unclear precisely how Snow took censuses beyond attempting

TABLE 3. **Population Density by Municipality: Select Census Years (Persons per Square Mile)**

Area	1920	1925	1930	1935	1958	1967	1970	1973	1980	1986
Kosrae	18.2	20.5	22.9	27.5	54.8	75.5	75.6	92.4	127.1	153.0
Lelu	NA	37.3	41.3	51.4	NA	124.2	197.1	165.5	238.3	289.4
Malem	NA	28.5	32.9	37.4	NA	107.3	86.1	120.7	167.1	207.3
Tafunsak	NA	16.4	18.4	22.0	NA	46.9	33.5	67.5	81.0	94.7
Utwe	NA	10.0	10.7	12.8	NA	47.6	42.5	59.5	77.7	91.7
Walung	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes: Although population was recorded for Walung Municipality in 1973, 1980, and 1986, an accurate figure for the area of this municipality is unavailable (see Bureau of Planning and Statistics, 1990:2); densities for Tafunsak Municipality, whose area includes Walung, thus represent the combined densities for both municipalities in these three years.

to visit both inhabited islands of the archipelago "to see the people at their homes, and to ascertain their number and circumstances" (American Board of Commissioners for Foreign Missions 1856: 190). The censuses reveal rapid depopulation for nearly two decades. Note that with the exception of the 1874 census, Snow did not record the number of non-Kosraens in residence; the population figures discussed in this section thus refer only to Kosraens residing in the archipelago.

In July 1855 Benjamin Snow recorded 1,106 persons living in Kosrae (American Board of Commissioners for Foreign Missions 1856: 190-191; see Table 1). Population estimates for earlier years suggest that a major phase of depopulation already had begun by this time, although the specifics remain uncertain. About 58 percent of the population were males (Table 4). Although detailed data on the age composition of the 1855 population of Kosrae are unavailable, 239 (21.6 percent) of the total were "boys and girls"--their precise ages unfortunately not specified.

By 1856 the population of Kosrae had declined to 975 persons, a decrease of 11.8 percent (*Missionary Herald* 1857:253; see Table 1). Data on the sex and basic age composition of the 1856 population are unavailable.

Snow conducted a third census of Kosrae in December 1857, the 830 persons present representing a decline of another 14.9 percent (*Missionary Herald* 1859:96; see Table 1). As in 1855, most residents counted in this census were male (62.4 percent) (see Table 4). Data on the basic age composition of Kosrae are unavailable for 1857.

Snow's fourth Kosrae census, (probably) conducted in 1858, revealed that depopulation had continued (see note 4); decreasing by 9.9 percent

TABLE 4. **Kosrae Population by General Age Categories and Sex: Select Years**

Year	Total Persons	All Ages (Percentage)		Children (Percentage)[a]	
		Males	Females	Males	Females
1855	1,106	58.0	42.0	12.9	8.7
1857	830	62.4	37.6	NA	NA
1858	748	59.9	40.1	4.9	5.6
1874[b]	397	59.7	40.3	15.6	13.3
1905	516	52.5	47.5	21.7	20.9
1947[c]	1,701	51.4	48.6	22.8	21.0

Sources: American Board of Commissioners for Foreign Missions 1856; *Missionary Herald* 1859, 1875; Damon 1861; Sarfert 1919; Lewis 1949.

[a]Ages were not precisely defined for 1855, 1858 ("younger children"), and 1874; percentages for 1905 and 1947 refer to persons aged less than 15 years. Percentages are of total population.

[b]The letter from Snow reporting the results of his 1874 census contains a bit of confusion regarding the number of children. In writing "of the 113 children, 62 are boys and 53 are girls" (*Missionary Herald* 1875:136), Snow provided figures that do not add up. The percentages calculated here are based on the numbers 62 and 53--assuming that he erred slightly in totaling the two.

[c]Although the 1947 census recorded 1,701 total persons, gender was available only for 1,686; percentage calculations use the latter number as denominator.

over the preceding year, the Kosrae population totaled only 748 persons (see Table 1). About 60 percent of the total were males, preserving the tendency observed earlier in the decade for males to dominate demographically (see Table 4). "Younger children and infants" represented 10.6 percent of the total 1858 population, with the remainder consisting of "adults and older children"; 46.8 percent of the youngest group were males (Damon 1861:42), a noteworthy reversal in the sex distribution of mid-nineteenth century populations for Kosrae.

Snow conducted his fifth and final census of Kosrae in October 1874, recording only 397 persons (*Missionary Herald* 1875:136). The rate of depopulation had slowed substantially since the previous census, to an average annual rate of about 3.9 percent (see Table 1). Males comprised 59.7 percent of the 1874 population; children made up about 29.0 percent of the total, with the majority of this youngest group male (53.9 percent) (see Table 4).

With the exception of Snow's reference to 125 deaths in 1855 (see Lewis 1949:50), no vital statistics are available from the period of missionary censuses. However, one can offer certain general propositions about mortality and fertility during this phase of Kosraen history based

on observations made by individuals who visited the island during the mid-nineteenth century. Mortality between 1855 and 1874 apparently was quite high; in the former year, the crude death rate reached an astronomical 113.0. Assuming that relatively few people left the island --a safe assumption given the generally limited mobility of Kosraens prior to the twentieth century (Ritter 1978:292-295) and the minimal impact of blackbirding (Lewis 1949:49)--high mortality would have caused most of the dramatic depopulation witnessed on Kosrae during this period. The high rates of death during these years primarily resulted from diseases introduced from outside Micronesia (Lewis 1949: 31, 50-52). Reduced fertility apparently also was a problem. For example, Snow noted only one infant while conducting his census of 1855 (American Board of Commissioners for Foreign Missions 1856:191). The causes underlying declining fertility are uncertain, though it is likely that venereal gonorrhea was the main culprit (Lewis 1949:54-57) --its effects exacerbated by depopulation in general, which reduced the number of women of childbearing age.

As noted above, Kosraens apparently did not travel frequently between islands during the period of missionary censuses, though some apparently left the island during the years of massive depopulation (Ritter 1978:293). However, inhabitants from other islands either visited or migrated to Kosrae. Included were Marshallese, who apparently visited Kosrae frequently, as well as people from Nauru, Ocean Island, and Rotuma (see Lewis 1949:49; Hezel 1983:241). At times, large numbers of the people residing on Kosrae were from elsewhere. Most of these non-Kosraens were temporary residents, though the durations of their stays varied substantially. Because the missionary censuses focused on Kosraens and recorded the precise number of non-Kosraens only once (excluded from the figures presented), the mobility patterns of other Micronesians have no bearing on the population of Kosrae documented by these early counts.

Kosrae Population during the German Period: 1905

Shortly after acquiring Spain's Micronesian possessions in 1899, Germany conducted censuses of several main islands, including Kosrae. Although the summary results of the Kosrae census are available (Sarfert 1919:49-58), detailed data on the geographic distribution and composition of the population by age and sex are not.

The German government recorded 516 residents in Kosrae in 1905 (see Table 1). This total represents almost 120 more persons than the

total recorded by the 1874 missionary census; Kosrae's population grew between these two census years at an average annual rate of 0.8 percent, though if the estimates during the 1880s are accurate, population actually grew more rapidly over the two decades preceding the 1905 census. Slightly more than half the Kosrae residents in 1905 were male (see Table 4) (Sarfert 1919:54). Some 220 persons (42.6 percent of the total) recorded by the German census were younger than 15 years old. As with the total population, a bit more than half (112 persons, or 50.9 percent) of those aged less than 15 years were male (Sarfert 1919:55).

Limited vital statistics and mobility data exist for Kosrae during the German period of occupation. The relatively large proportion of young persons in the population suggests that the infertility prevalent during the last half of the nineteenth century was no longer a problem. The presence of twenty-four families with four or more children in 1905 (Sarfert 1919:58) supports this general contention, though precise fertility calculations are impossible. Interisland mobility apparently increased slightly during the German administration, primarily in the form of Kosraen men working in the phosphate mines on Nauru. Some of these men married Nauruan women and returned with their families, and at least two Americans and one Filipino resided in Kosrae during the German administration (Ritter 1978:295). However, most of the population increase in Kosrae over the three decades preceding the 1905 census almost certainly resulted from natural growth.

Kosrae Population during the Japanese Period: 1920, 1925, 1930, and 1935

In 1920 the Japanese South Seas Bureau conducted its first census of Kosrae (then part of the Pohnpei District of the Mandated Territory; see Nan'yō-chō 1937). The South Seas Bureau conducted similar censuses in 1925, 1930, and 1935, providing an extremely detailed demographic database for the period of Japanese administration. These data describe a steadily increasing population, with the average annual growth between census years over this fifteen-year period ranging from 2.2 to 3.7 percent. I discuss the four Nan'yō-chō censuses briefly below, focusing on Pacific Islanders and for the most part excluding any examination of resident Japanese.[5]

Nearly 800 Pacific Islanders resided in Kosrae in 1920 (Nan'yō-chō 1937; see Table 1). This number represents the result of sustained demographic growth following the German census in 1905, with the native population increasing at an average rate of about 2.8 percent annually.

The 1920 census recorded the total population of Kosrae but did not record the population of component municipalities.

The number of Pacific Islanders residing in Kosrae increased by 100 persons between 1920 and 1925 (see Table 1), the average annual growth slowing to 2.4 percent (Nan'yō-chō 1927). The 1925 census recorded population for each municipality in Kosrae with the exception of Walung, a more recently defined municipality that the 1925 census combined with Tafunsak (see Table 2). Most Pacific Islanders resided in Lelu and Tafunsak municipalities, each jurisdiction containing about one-third of the archipelago's population. Utwe Municipality contained the fewest Pacific Islanders in 1925--a tendency that would continue until 1973 when newly defined Walung Municipality replaced Utwe as the municipality with the smallest number of residents. The 1925 census recorded the age-sex composition of Kosrae as part of the Pohnpei District of the Mandated Territory; the resulting population pyramid appears elsewhere (Gorenflo and Levin 1992c:15), though the relatively small contribution of Kosrae to the total district population suggests that one should view this figure with caution in the present context.

The population of Kosrae grew by more than 100 persons between 1925 and 1930 (see Table 1), increasing at an average annual rate of 2.2 percent (Nan'yō-chō 1931). In 1930 the number of Pacific Islanders had grown in each municipality over the preceding five years (see Table 2), with the growth rates in Malem and Tafunsak greater than that for Kosrae as a whole. As in 1925, Lelu and Tafunsak municipalities each contained about one-third of the total population. For the first time, the 1930 census recorded information on the age composition of the resident population, both for Kosrae and for each municipality (Table 5). The composition of all municipalities except Tafunsak were similar to one another--Tafunsak containing a particularly large proportion of persons aged between 15 and 24 years. Data on the detailed age-sex composition of Kosrae also are available for the first time in 1930 (Figure 3).

Little information on births, deaths, and mobility in Kosrae is available for the years of Japanese administration. Pertinent data in general are scarce for this period, the lack of information exacerbated by the tendency to record Kosrae as part of the Pohnpei District of the Mandated Territory. The 1930 census contained the first systematically recorded information on mobility for Kosrae, in the form of residency by place of registration (Table 6). These data indicate that the majority of the archipelago's population in 1930 was registered in some part of the Pohnpei District, primarily Kosrae itself. The greatest mobility occurred in Tafunsak and Utwe municipalities, with migration to the

TABLE 5. **Pacific Islander Population by Age and Municipality: 1930**

Area	Total Persons	Age Group (Percentage)			
		0-14	15-24	25-59	60+
Kosrae	990	44.5	22.6	30.2	2.6
Lelu	346	46.0	18.8	32.1	3.2
Malem	215	45.6	19.1	32.1	3.3
Tafunsak[a]	304	41.8	31.6	24.7	2.0
Utwe	125	45.6	17.6	35.2	1.6

Source: Nan'yō-chō 1931.

Note: In this and following tables, percentages may not sum to precisely 100.0% due to rounding. Other reasons for not summing to 100.0% are noted in each case.

[a]In 1930 Tafunsak Municipality contained the area presently defined as Walung Municipality.

former possibly accounting for its different age composition in 1930. The Japanese administration recorded fertility data between 1926 and 1930 for the Pohnpei District of the Mandated Territory; with a general fertility rate ranging between 101.5 (1929) and 139.1 (1930), fertility was slightly higher for this district than for others in the territory (Yanaihara [1940] 1967:35). Once again, a cautionary note is in order when considering these data, as Kosrae comprised only a portion of the district.

Kosrae population continued to increase over the first half of the 1930s, the average annual growth rate of 3.7 percent resulting in a total of 1,189 Pacific Islander residents in 1935 (Nan'yō-chō 1937; see Table 1). As in 1930, the 1935 census indicates that the populations of all four municipalities in Kosrae grew since the previous census, with the number of residents in Lelu Municipality increasing the fastest both in relative and absolute terms (see Table 2). Nevertheless, the relative distribution of population among municipalities remained generally what it was in 1925 and 1930. In 1935 the age composition of Kosrae as well as its component municipalities was similar to that documented in 1930--with the relatively large proportion of Tafunsak Municipality population aged 15 to 24 years once again evident (Table 7). The age-sex composition of Kosrae in 1935 also was similar to that recorded in 1930 (see Figure 3).

Data on possible causes of population change in Kosrae between 1930 and 1935 are unavailable. Vital statistics recorded for the Pohnpei District in 1937 indicate a general fertility rate of 113.0 and a crude death rate of 15.7 (Office of the Chief of Naval Operations 1944:30), suggest-

TABLE 6. **Pacific Islander Population by Place of Registration, According to Municipality of Residence: 1930**

Area	Total Persons	Percentage			
		Same Locality	Same District[a]	Other District[a]	Other Location[b]
Kosrae	990	73.7	18.3	6.3	1.7
Lelu	346	83.2	14.5	2.3	
Malem	215	82.3	10.7	0.9	6.0
Tafunsak[c]	304	60.2	21.7	16.8	1.3
Utwe	125	65.6	33.6	0.8	

Source: Nan'yo-cho 1931.

[a]Refers to major island districts within the Mandated Territory (here Pohnpei District, as Kosrae was part of that district in 1930).

[b]Refers to locations outside of the Mandated Territory.

[c]In 1930 Tafunsak Municipality contained the area presently defined as Walung Municipality.

TABLE 7. **Pacific Islander Population by Age and Municipality: 1935**

Area	Total Persons	Age Group (Percentage)			
		0-14	15-24	25-59	60+
Kosrae	1,189	46.7	19.8	30.0	3.4
Lelu	430	50.2	11.9	34.2	3.7
Malem	244	44.7	18.4	32.4	4.5
Tafunsak[a]	365	42.5	30.7	23.8	3.0
Utwe	150	50.0	18.7	29.3	2.0

Source: Nan'yo-cho 1937.

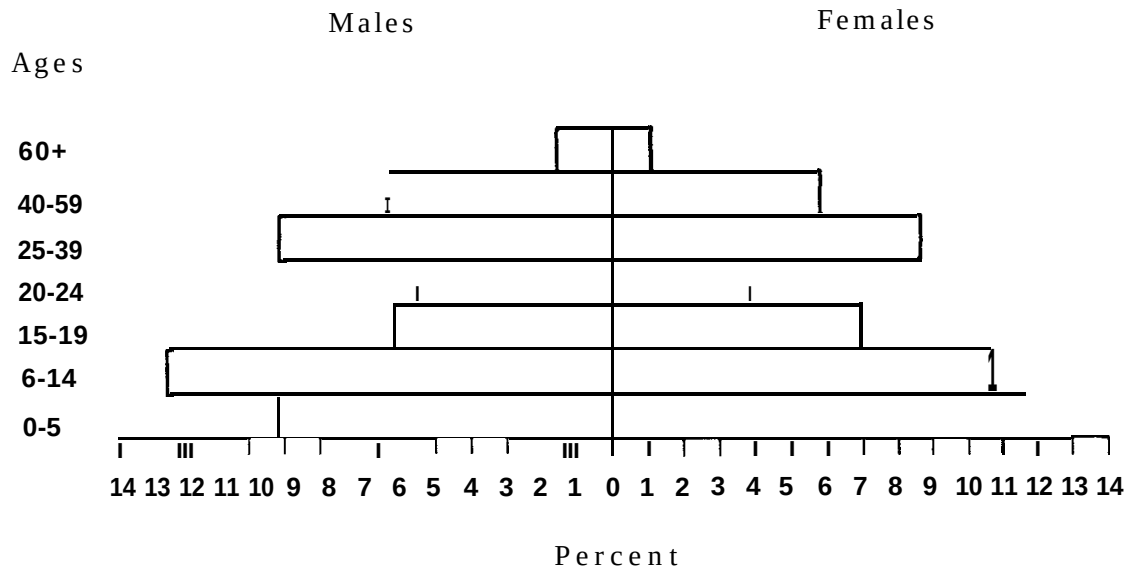
[a]In 1930 Tafunsak Municipality contained the area presently defined as Walung Municipality.

ing that natural growth played an important role (see Gorenflo and Levin 1992c:32). The 1935 Nan'yō-chō census did not record data on mobility for Kosrae.

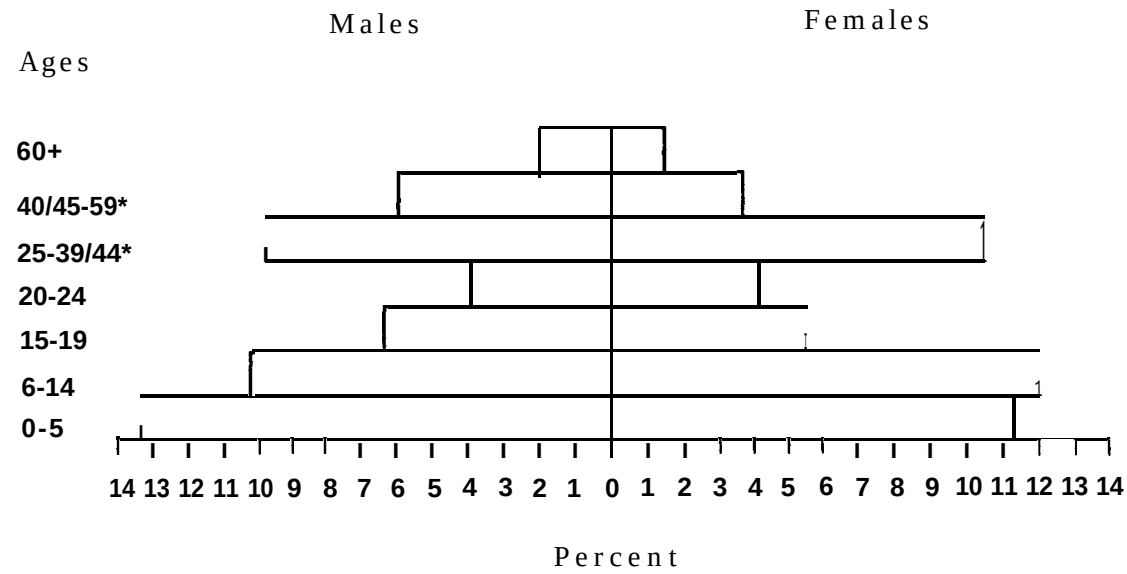
Kosrae Population in 1947

Shortly after beginning its administration of Kosrae, the U.S. Navy conducted a census of Lelu and Ualang islands. However, the total of 1,701 residents (Lewis 1949:48) does not equal the sum of males (867) and

Age and Sex Distribution for Kosrae State: 1930



Age and Sex Distribution for Kosrae State: 1935



* Different ages used for males (25-39. 40-59) and females (25-44. 45-59).

FIGURE 3. **Population pyramids (Pacific Islanders only): 1930, 1935.**

females (819) recorded (Lewis 1949:51). In the absence of other data, I shall assume that the former number is correct and that the latter two resulted from a failure to specify gender for all individuals during the census (leading to a group of persons whose sex was "not stated") or referred to counts at different times in 1947 (Lewis notes counts for both July [1949:51] and October [1949:56]). With a difference of only 15 persons, the effect of selecting the incorrect total here is minimal. The 1947 population of Kosrae resulted from an average annual increase of about 3.0 percent over the twelve years following the final Japanese census (see Table 1). Population figures for individual municipalities are unavailable. Males comprised 51.4 percent of the persons for whom gender was known, while individuals younger than 15 years represented 43.8 percent of the total (see Table 4).

Vital statistics are unavailable for 1947, though the large percentage of total population aged less than 15 years suggests that fertility was relatively high and infant mortality relatively low. Similarly, there are no reliable data on mobility for 1947.

Kosrae Population in 1958

In 1958, the Office of the TTPI High Commissioner conducted a systematic census of Kosrae and the remainder of the Trust Territory (Office of the High Commissioner 1959). Resulting data indicate that the population continued to increase rapidly following the first postwar census, the total of nearly 2,400 persons resulting from an average growth of approximately 3.0 percent annually. Apart from the total population, little is known of Kosrae demography in 1958. Population data for municipalities are unavailable, as are data on age composition and reliable vital statistics. A figure depicting the age-sex composition for the Pohnpei District of the TTPI, of which Kosrae was a part, appears elsewhere (Gorenflo and Levin 1992c:20). Again, care is warranted when applying this information to Kosrae.

Kosrae Population in 1967

The 1967 census indicates that the population of Kosrae had grown by nearly 900 persons over the preceding nine years (see Table 1), at the substantial average annual growth rate of about 3.6 percent (School of Public Health n.d.). The geographic distribution of population possibly changed from the Japanese period, with decreases in the proportion of total population residing in Lelu and Tafunsak municipalities countered

in part by a relative increase in Utwe Municipality (see Table 2). However, because the residence of 5.6 percent of the population in 1967 was not specified, these apparent changes may be due in part to data deficiencies.

The proportion of persons in the youngest and oldest age groups examined in this study increased between 1935 and 1967, with the size of other age groups decreasing accordingly (Table 8). The distribution of ages in individual municipalities varied slightly in 1967, though one must temper any conclusions drawn from these figures, owing to the 184 individuals whose residence in 1967 was not specified. One characteristic of the age composition of individual municipalities worth noting is the similarity of Tafunsak with the remainder of Kosrae, in contrast to its composition during the Japanese administration. Figure 4 presents the age-sex composition of Kosrae as a whole, by the conventional five-year age groups not presented in the Nan'yō-chō census reports.

Three measures of fertility for Kosrae in 1967 indicate a substantial increase over the fertility recorded for the Pohnpei District of the Mandated Territory in the late 1930s (Table 9). This high fertility helps to account for the demographic growth experienced in the nine years preceding the 1967 census. Natality data also are available by municipality in 1967, the variability between jurisdictions still preserving high fertility throughout the archipelago (Table 10). Data on mortality in 1967 are available by five-year age group for Kosrae as a whole (Table 11).

TABLE 8. **Population by Age and Municipality: 1967**

Area	Total Persons	Age Group (Percentage)			
		0-14	15-24	25-59	60+
Kosrae	3,260	51.0	17.7	25.1	4.6
Lelu	1,040	50.9	19.3	23.3	5.7
Malem	701	50.5	15.8	27.0	4.7
Tafunsak[a]	777	52.0	16.9	25.0	3.6
Utwe	558	49.1	19.9	26.5	3.4
Not otherwise stated	184	54.9	13.0	25.0	5.4

Source: School of Public Health n.d.

Note: Percentages may not sum to precisely 100.0% due to the exclusion of 18 individuals whose ages were "not specified" and 34 "foreign born" individuals, whose specific ages similarly were not specified.

[a]In 1967 Tafunsak Municipality contained the area presently defined as Walung Municipality.

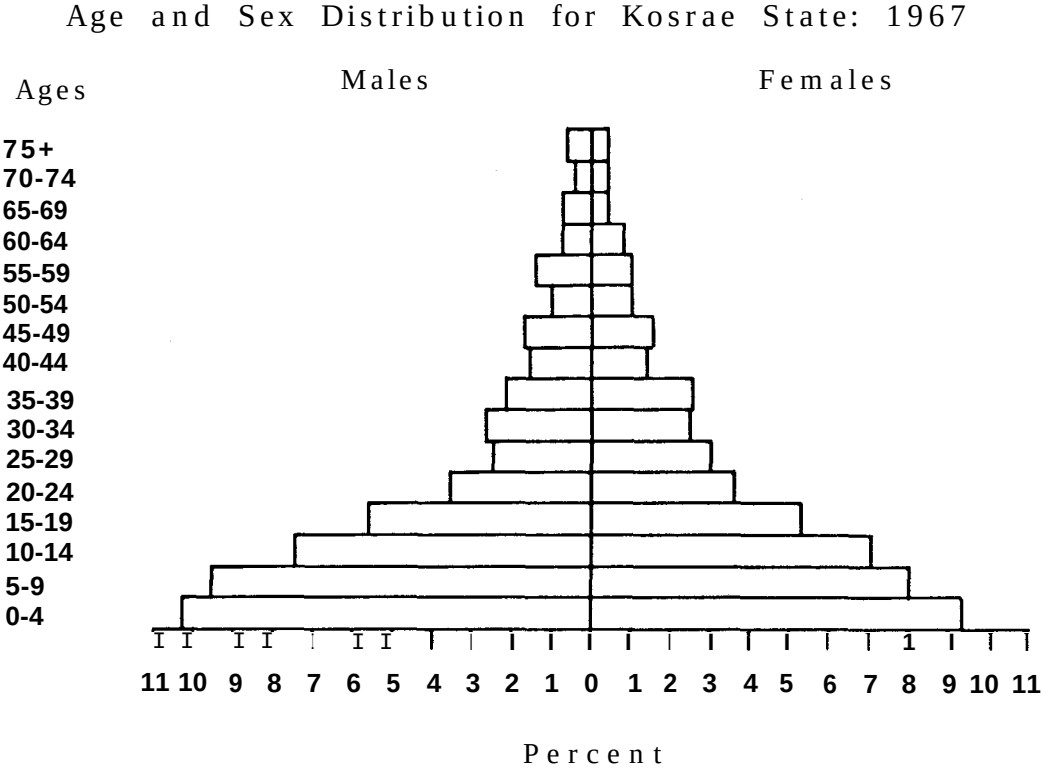


FIGURE 4. **Population pyramid: 1967.**

Overall mortality, measured in terms of crude death rate, was less than one-half that recorded for the Pohnpei District in 1937 (Table 12); this measure coupled with high fertility explains the rapid natural increase in population.

Kosrae Population in 1973

Although the U.S. Bureau of the Census conducted a census of Kosrae in 1970, the resulting data indicate a substantial undercount. I present the 1970 figures in tables 1 and 2 in part for completeness and in part to show evidence for the likely undercount--with sixty-five years of rapid population growth interrupted by this single year (see Gorenflo and Levin 1991, 1992c).

In 1973 the TTPI administration conducted a census of all inhabited islands within its jurisdiction. The population of Kosrae increased by nearly 750 persons over the preceding six years, at an average annual rate of 3.4 percent (Office of Census Coordinator 1975). All municipalities gained population between 1967 and 1973 (the figures for Tafunsak and Walung municipalities were considered together in the latter year

TABLE 9. **Measures of Fertility for Kosrae: Select Years**

Year	Total Persons	Total Births	Crude Birth Rate	General Fertility Rate	Total Fertility Rate
1967[a]	18,304	616	33.7	176.3	6,246
1970[a]	18,536	773	41.7	205.2	7,206
1973[a]	23,252	817	35.1	176.0	5,953
1980[b]	5,491	105	19.1	89.8	2,447
1986[c]	6,607	235	35.6	161.2	5,372

Sources: School of Public Health n.d.; U.S. Bureau of the Census 1972, 1983a; U.S. Dept. of State 1982; Bureau of Planning and Statistics 1990; Office of Planning and Statistics 1989.

[a]Measures for 1967, 1970, and 1973 incorporate births for Kosrae and the Pohnpei District, as births for these *areas* were not reported separately until 1976. Population figures for those years similarly are for Kosrae and the Pohnpei District combined.

[b]Measures for 1980 differ from those presented in Table 10 due to conflicting data. The data here are reported births in all of Kosrae for each year and thus should be comparable across years (though the fertility measures all appear extremely low). These same data are not available for each municipality, forcing me to employ different sources for Table 10.

[c]I calculated natality measures for 1986 based on data presented in Bureau of Planning and Statistics 1988. These figures disagree with those presented in Office of Planning and Statistics 1989:92-93, where total fertility rate was estimated at 5,460.

to enable comparison, as demographic data were collected from Walung Municipality for the first time in 1973). The geographic distribution of population in 1973 resembled that of 1967, with the proportion of persons residing in Lelu and Tafunsak-Walung municipalities increasing slightly (see Table 2). The age-sex composition of the 1973 Kosrae population generally was similar to that documented for the 1967 population, though the proportion of males decreased by about 1.2 percent (Figure 5). Data on the age composition of individual municipalities are unavailable for 1973.

Although 1973 fertility data are available for the Pohnpei District of the TTPI, they are not available for that portion of the district comprising Kosrae. As a consequence, one must proceed with caution when making comparisons--as was the case with vital statistics from the Japanese administration. In 1973 Pohnpei District fertility was similar to Kosrae fertility in 1967, with a slight increase in the crude birth rate and slight decreases in the other two measures examined (see Table 9). Mortality data also were available only at the district level in 1973. Deaths occurred in more age groups in the Pohnpei District in 1973 than they did in Kosrae in 1967 (see Table 11), though this probably is a consequence of the larger district numbers. A drop in the overall crude

TABLE 10. **Fertility Measures by Municipality: 1967 and 1980**

Area	1967					1980				
	Total Persons	Total Births[a]	Crude Birth Rate	General Fertility Rate	Total Fertility Rate	Total Persons	Total Births	Crude Birth Rate	General Fertility Rate	Total Fertility Rate
Kosrae	3,260	127	39.0	191.3	6,972	5,491	230	41.9	196.7	7,185
Lelu	1,040	42	40.4	204.2	7,818	1,995	103	51.6	249.4	9,499
Malem	701	31	44.2	187.1	6,501	1,091	33	30.2	146.0	5,160
Tafunsak	777	32	41.2	187.9	6,777	1,342	75	55.9	268.8	10,056
Utwe	558	22	39.4	179.5	6,991	912	9	9.9	41.7	1,573
Walung	. . .	. . .	. . .	. . .	. . .	151	10	66.2	285.7	12,340

Sources: School of Public Health n.d.; U.S. Bureau of the Census 1983b.

[a]1967 natality is based on figures for living infants 1 year old and younger and thus excludes individuals who died during the first year of life. Total births include 14 infants born to mothers aged under 15, over 49, and of unknown age (used for crude fertility rate, but not general or total fertility rates).

TABLE 11. **Deaths in Kosrae, Percentages by Age Group: 1967, 1970, 1973, 1980**

Age Group	1967	1970[a]	1973[a]	1980
	Number			
Total Persons	3,260	18,536	23,252	5,491
	Percentage			
All Ages	100.0[b]	100.0	100.0	100.0
< 1	19.0	16.7	25.3	22.2
1-4	19.0	5.3	7.7	5.6
5-9	-	2.6	2.2	5.6
10-14	-	5.3	1.1	-
15-19	4.8	2.6	-	-
20-24	-	2.6	5.5	5.6
25-29	-	2.6	1.1	-
30-34	-	1.8	5.5	5.6
35-39	4.8	2.6	3.3	-
40-44	-	3.5	6.6	5.6
45-49	9.5	5.3	8.8	11.1
50-54	-	3.5	7.7	-
55-59	-	5.3	5.5	-
60-64	-	7.0	6.6	11.1
65-69	4.8	7.9	-	-
70-74	4.8	5.3	1.1	27.8
75+	28.6	20.2	12.1	-

Sources: 1967 calculations are based on data on deaths in the 11.5 months preceding the 1967 census, as presented in School of Public Health n.d.; 1970 and 1973 calculations on data on deaths for each calendar year in U.S. Dept. of State 1981; and 1980 calculations on deaths for the 1980 calendar year in U.S. Dept. of State 1982.

[a]Calculations for 1970 and 1973 combine Kosrae and the Pohnpei District, as age-specific mortality data presented for those years did not distinguish between these two areas.

[b]Percentages for 1967 do not sum to precisely 100.0 due to one individual whose age at death was "not specified."

death rate, mortality of individuals aged less than 1 year, and mortality of individuals aged more than 74 years is evident (see Table 12). If these fertility and mortality data for the Pohnpei District hold for Kosrae as a whole (as they probably do), one may once again explain population growth between 1967 and 1973 by an excess of births over deaths.

As with much of the population data, data on mobility in Kosrae in 1973 are available for Kosrae as a whole but not for individual municipalities. Of the TTPI-born de facto population of Kosrae in 1973, 98.6 percent claimed Kosrae as their place of usual residence (Office of Cen-

TABLE 12. **Age-Specific Death Rates in Kosrae: 1967, 1970, 1973, 1980**

Age Group	1967	1970[a]	1973[a]	1980
Total	6.44	6.15	3.91	3.28
< 1	29.63	21.84	23.21	17.78
1-4	8.05	2.40	2.11	1.26
5-9	-	1.02	0.55	1.15
10-14	-	2.28	0.31	-
15-19	2.85	1.48	-	-
20-24	-	2.16	2.68	1.99
25-29	-	3.27	0.83	-
30-34	-	2.40	5.04	3.08
35-39	6.90	3.50	3.01	-
40-44	-	5.18	6.39	5.65
45-49	19.23	7.99	9.96	10.93
50-54	-	6.88	8.55	-
55-59	-	13.95	8.64	-
60-64	-	22.79	13.42	24.69
65-69	25.00	31.69	-	-
70-74	38.46	39.74	4.26	111.11
75+	193.55	96.64	43.48	-

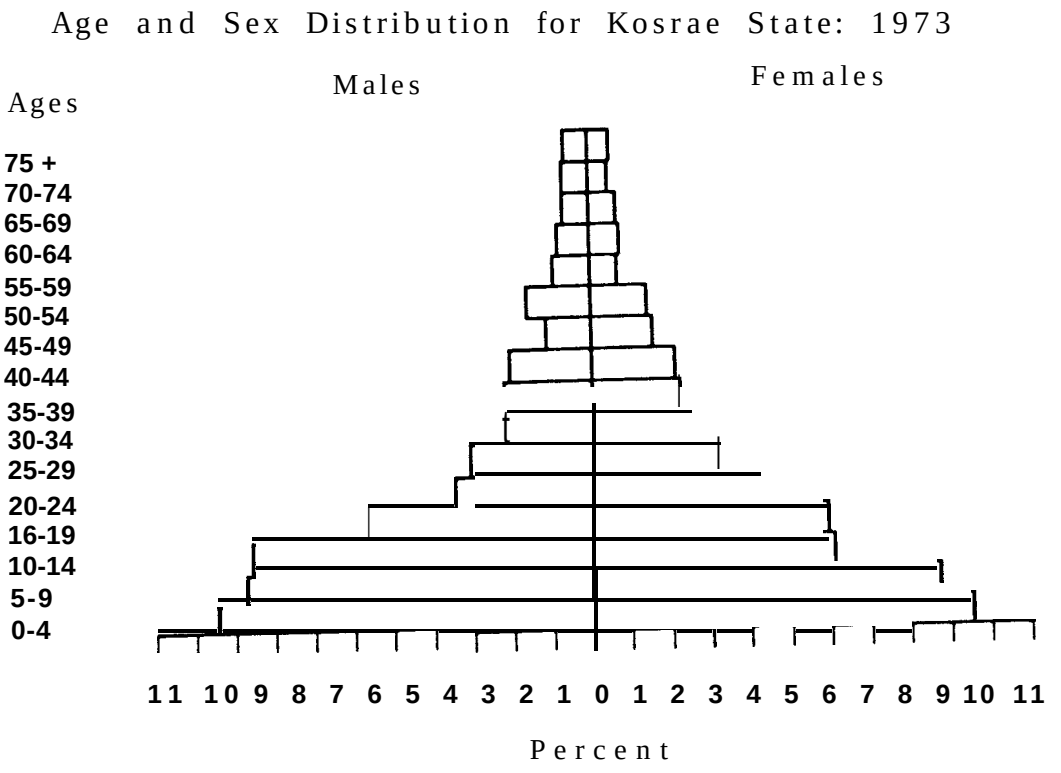
Sources: See Table 11.

[a]Calculations for 1970 and 1973 combine Kosrae and the Pohnpei District, as age-specific mortality data presented for those years did not distinguish between these two areas.

sus Coordinator 1975: 130). Most of the remaining TTPI-born residents in 1973 came from elsewhere in the Pohnpei District or from some other part of the TTPI. Mobility data also are available as migration destinations (places of usual residence within the TTPI) of persons born in Kosrae. In 1973 86.7 percent of TTPI residents born in Kosrae still resided in Kosrae, with most of the remainder living elsewhere in the Pohnpei District (6.0 percent, most of whom probably resided on Pohnpei Island) or in the Marshall Islands (4.9 percent) (see Office of Census Coordinator 1975: 103).

Kosrae Population in 1980

The U.S. Bureau of the Census conducted a second detailed census of the Trust Territory in 1980 (U.S. Bureau of the Census 1983a), recording demographic data for the entire state of Kosrae as well as for individual municipalities (Table 13). Population growth was extremely rapid for the last part of the 1980s the addition of more than 1,500 persons resulting from remarkably rapid average annual growth of 4.7



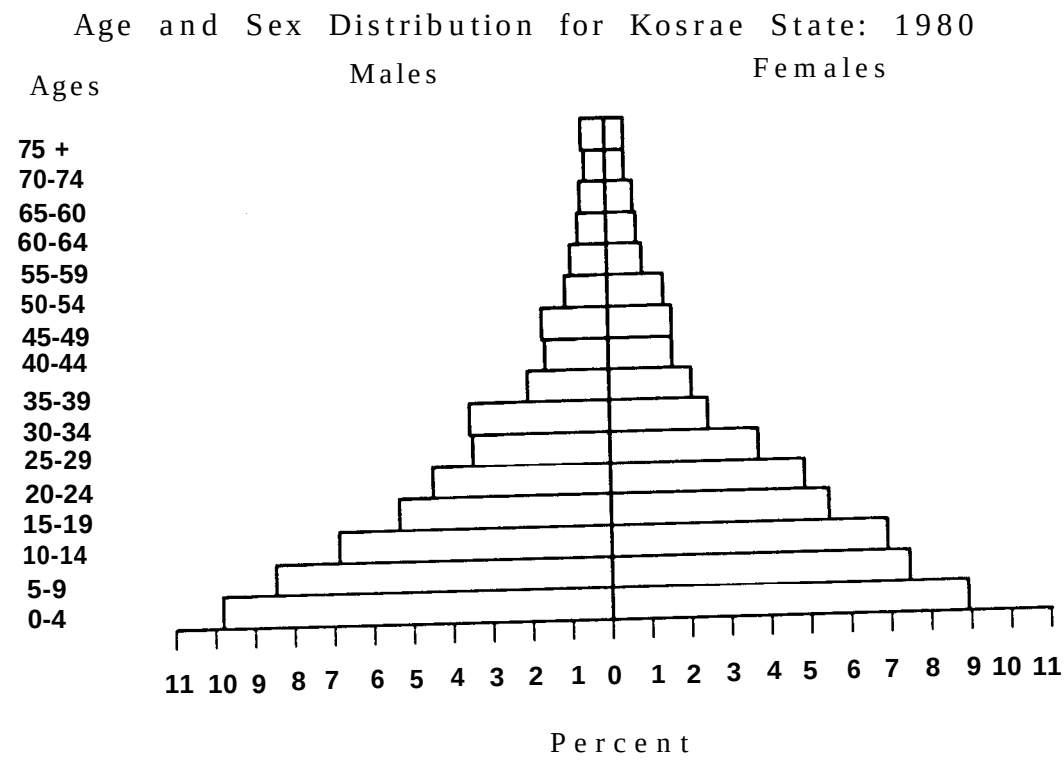


FIGURE 5. **Population pyramids: 1973, 1980.**

TABLE 13. **Population by Age and Municipality: 1980**

Area	Total Persons	Age Group (Percentage)			
		0-14	15-24	25-59	60+
Kosrae	5,491	48.0	19.7	27.6	4.6
Lelu	1,995	47.9	20.0	27.3	4.8
Malem	1,091	50.4	16.7	27.4	5.5
Tafunsak	1,342	45.5	21.5	29.0	4.0
Utwe	912	49.8	19.1	26.4	4.7
Walung	151	44.4	24.5	29.1	2.0

Source: U.S. Bureau of the Census 1983a.

percent after 1973 (see Table 1). Once again, the population of each municipality increased, with the greatest growth experienced in Lelu Municipality (see Table 2).

Figure 5 shows the age-sex distribution of Kosrae population in 1980, revealing general similarities with the 1973 distribution. The composition of municipality populations by age indicates variability between places, such as relatively fewer persons in the oldest and youngest age groups examined residing in Walung Municipality and relatively more of these same age groups residing in Malem Municipality (see Table 13). Slight changes from 1967 are apparent, with relative decreases in persons aged less than 15 years evident among three of the four municipalities where comparisons are possible.

Vital statistics are available for Kosrae in 1980, but they are not entirely comparable to figures presented earlier that combine Kosrae and Pohnpei states. In Table 9 low values are evident for all three fertility measures considered--usually on the order of half the values for the Pohnpei District of the TTPI in 1967, 1970, and 1973. These measures disagree with the 1980 figures presented in Table 10, the latter indicating particularly high fertility. Given the extremely rapid growth of population in Kosrae during the 1970s coupled with the general tendency in Micronesia to underreport vital statistics (affecting the measures presented in Table 9, which are based on *reported* births), the Table 10 values are more likely correct (see also Office of Planning and Statistics 1989:30). Fertility measures for individual municipalities indicate substantial variability between different parts of Kosrae (see Table 10). Mortality data also are available for Kosrae in 1980. Most of the deaths registered for the state as a whole occurred among infants and individuals aged between 70 and 74 years (see Table 11). Mortality for infants was lower than for any of the previous three years examined (see Table

12); mortality for the latter group was much higher than for any of the years discussed above.

The 1980 census also recorded data on mobility in Kosrae. Notice that because the census defined mobility in terms of place of residence five years earlier, these figures are not strictly comparable to the lifetime mobility data presented for 1930 and 1973 (see Gorenflo and Levin 1992a). The information available indicates that the vast majority of Kosrae residents in 1980 lived in the same municipality where they resided in 1975 (Table 14). Lelu Municipality featured the largest absolute and relative number of 1980 residents who lived elsewhere five years earlier--some coming from other parts of Kosrae State, some from other portions of the TTPI or beyond.

Kosrae Population in 1986

The FSM Office of Planning and Statistics conducted the most recent census of Kosrae in 1986 (Office of Planning and Statistics 1989), once more providing demographic data at the municipality level (Table 15). The total population recorded by this census was 6,607 persons, indicating that population growth in excess of 3.0 percent annually had continued into the 1980s (see Table 1). The number of inhabitants increased in each municipality between 1980 and 1986 (see Table 2), at average annual growth rates ranging from 2.6 to 3.7 percent.

TABLE 14. **Population by Municipality and Place of Residence in 1975: 1980**

Area	Total Persons[a]	Percentage			
		Same Municipality	Elsewhere in Kosrae	Elsewhere in TTPI	Outside TTPI
Kosrae	4,330	92.2	1.5	3.2	3.0
Lelu	1,590	87.3	3.0	5.3	4.4
Malem	855	96.4	0.4	1.2	2.1
Tafunsak	1,079	91.7	0.8	3.4	4.1
Utwe	686	98.8	-	1.2	-
Walung	120	94.2	5.0	0.8	-

Source: U.S. Bureau of the Census 1983b.

Note: This table does not include two individuals whose place of residence in 1975 was not given.

[a]Includes only those individuals older than 5 years of age.

The age-sex distribution in 1986 differed slightly from that recorded in 1980, with minor shifts in the proportional representation of several age groups younger than 30 years (Figure 6). Municipalities in Kosrae varied in terms of their age composition: Utwe Municipality contained

TABLE 15. **Population by Age and Municipality: 1986**

Area	Total Persons	Age Group (Percentage)			
		0-14	15-24	25-59	60+
Kosrae	6,607	47.0	18.0	30.2	4.8
Lelu	2,422	45.9	17.8	31.3	5.0
Malem	1,354	45.1	19.9	29.2	5.8
Tafunsak	1,568	47.2	19.2	29.7	3.9
Utwe	1,076	51.9	14.9	28.9	4.4
Walung	187	45.5	13.9	34.8	5.9

Source: Office of Planning and Statistics 1989.

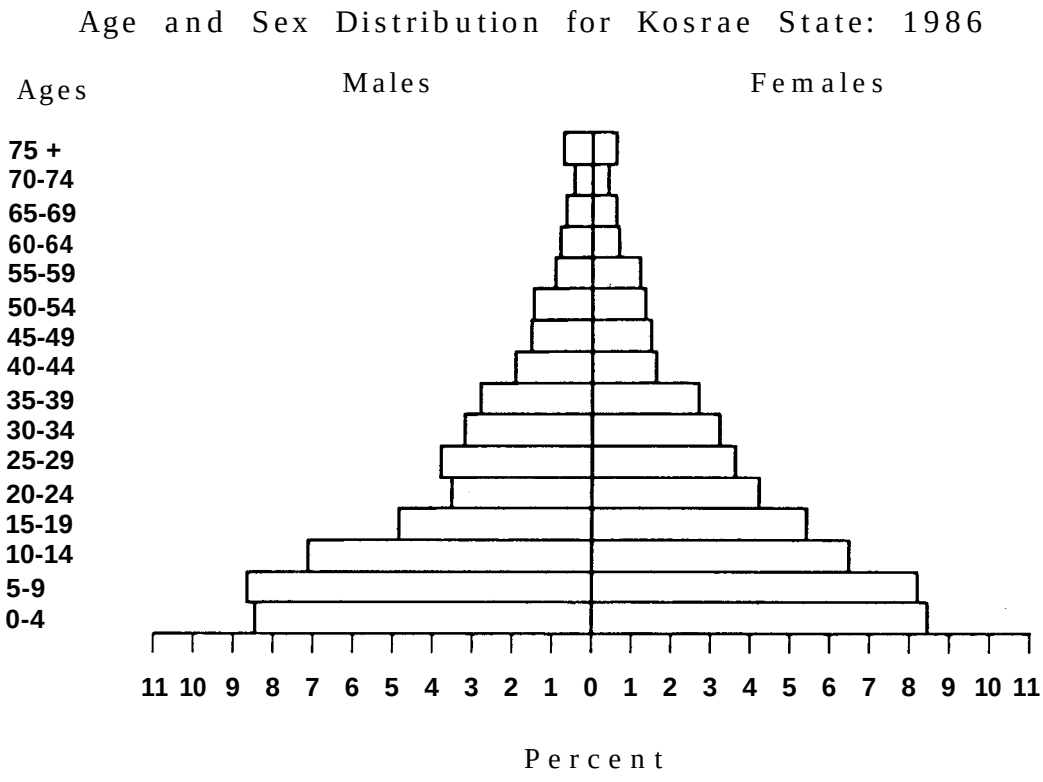


FIGURE 6. **Population pyramid: 1986.**

a relatively large proportion of persons aged 14 years or less; Malem and Walung municipalities contained relatively large proportions of persons aged 60 years or more (see Table 15). Compared to 1980, relatively fewer persons were aged 24 years or less and relatively more persons were older than 24 years in most municipalities.

Based on the information recorded, fertility for Kosrae State was relatively high in 1986 (see Table 9). Depending upon the 1980 data one relies on, fertility could have increased or decreased over the first six years of the decade (see tables 9 and 10), though based on the earlier discussion of 1980 vital statistics, the latter trend is more likely. Crude death rate in 1986 ranged between 6.1 and 6.5, depending on the mortality data one employs (see Bureau of Planning and Statistics 1990:124, 127). The FSM Office of Planning and Statistics estimated infant mortality at between 45 and 50 in 1986 (Office of Planning and Statistics 1989:33); although substantially higher than infant mortality presented above either for Kosrae or for the Pohnpei District of the TTPI, an effort to account for the underreporting of infant deaths in 1986 may explain the difference. Reliable mortality data for the remainder of Kosrae age groups unfortunately are unavailable for 1986. Mobility data similarly are unavailable. Despite these deficiencies, once again an excess of births over deaths probably accounted for most of the rapid population growth through the first half of the 1980s.

Underlying Causes of Population Dynamics

As described in the preceding pages, Kosrae demography changed substantially over a relatively brief period of time. Between 1828 and 1855 the population of this small archipelago declined from an estimated 3,000 to 1,106, a reduction of more than 63 percent in less than three decades; by the 1880s, the population declined still further to about 300 total Kosraens (see Ritter 1978:55; Ritter 1981b:21, 25-26). Kosrae population subsequently began a period of sustained growth, probably in the 1880s or 1890s. Between the German census in 1905 and the most recent census in 1986, the number of residents increased at an average annual rate of 3.2 percent, the total in the latter year nearly thirteen times that in the former. Thus over a period of 158 years Kosrae's population nearly disappeared and then grew to levels greater than any previously documented. Two questions are important in such a situation: what caused such dramatic population changes, and what were the broader ramifications of extreme population decline and growth? I deal with the first question now and the second question in the section on cultural, ecological, and economic repercussions that follows.

Of the three main mechanisms of population change--mortality, fertility, and migration--the first probably was the main cause of depopulation in Kosrae during the nineteenth century. Extremely high mortality apparently was not a problem at the time of contact, with early visitors in the 1820s noting the presence of large numbers of residents, including many old persons (Lesson 1839, 2:493). In scarcely two decades the situation changed substantially, largely owing to disease. William Jackson, who visited Kosrae in early 1848, wrote that the Kosraens "are in a deplorable condition. There is a general sickness prevailing, a species of fever. . . . Some were dieing *[sic]* daily, and I think unless they have some relief, all the inhabitants must in a few years be swept away" (1849:10). Captain Caloft of the *Hobeoricock*, visiting Kosrae in 1850, echoed Jackson's earlier concerns, providing valuable clues to the maladies present when he reported that "population is now decreasing, through the prevalence of colds, consumption and other diseases" (*The Friend* 1850:68). The sickness of which Caloft spoke was probably influenza or some related respiratory disorder (Hezel 1983: 141-142). During 1855, the year in which he conducted his first census, Benjamin Snow counted 125 deaths, 113 of which he blamed on influenza (see Lewis 1949:50). This disease was prevalent between 1855 and 1859, probably causing most of the 476 deaths recorded during these four years and as much infant mortality. Although epidemics had ended by 1880, when visitors reported the population in good health (Finsch 1893), the damage was done; the number of residents had declined dramatically, and the demographic structure of the remaining population had been modified so that the final phases of depopulation probably resulted from the inability of the few Kosraens of childbearing age to reproduce as quickly as old persons died (Lewis 1949:51).

Influenza was not the only disease that affected the residents of Kosrae during the nineteenth century. Early visitors noted the presence of skin diseases that featured ulcers and lesions (Kittlitz 1858, 2:11; see also Lewis 1949:50), though some questioned their prevalence (Lütke 1835, 1:406). During the nineteenth century, most generally felt that the disease they were seeing was syphilis (see Ritter 1978:56-58), usually alluding to a "foul" (Jackson 1849: 10) or "moral and physical" (American Board of Commissioners of Foreign Missions 1856:191) disease, or metaphorically to the "wages of sin" (Gulick 1862:245), rather than naming syphilis itself (Hammet 1854:64). However, Lewis provided a compelling argument against the presence of syphilis in Kosrae during the nineteenth century, suggesting that early observers had confused it with yaws (1949:52-55). The symptoms of syphilis and yaws are similar, particularly in their later stages. Moreover, because microscopic

parasites of the genus *Treponema* cause both diseases, exposure to one malady generally provides immunity to the other (Pirie 1971:192). Given the prevalence of yaws throughout much of Micronesia during the nineteenth century, the likelihood that it did not exist in Kosrae is remote (Lewis 1949:55; see also Ritter 1978:57-60). Additional support for the presence of yaws in Kosrae came when researchers documented outbreaks of the disease during the present century (Wilson 1968:35). In the present study the distinction between these two diseases is important for, in contrast to syphilis, yaws usually is relatively mild. Although yaws can become serious, it is not necessarily fatal and thus would have had little impact on mortality (Pirie 1971:195-196).

Other possible causes of high mortality in Kosrae existed in the early and mid-nineteenth century. Although a devastating typhoon apparently struck in the early 1800s such powerful storms generally are rare in the Eastern Carolines, and later examples in the nineteenth century apparently had minimal demographic impacts. Numerous internal conflicts that occurred in Kosrae during the 1800s led to an unknown number of deaths. An uprising of commoners shortly before the arrival of Europeans, possibly in the aftermath of the typhoon noted above, contributed to the eradication of up to half the native population (Ritter 1981b:25). Subsequent internal conflicts in 1837 and 1857 similarly led to the deaths of more Kosraens, though precise numbers are unknown (*Missionary Herald* 1859:98; Lewis 1949:18, 32; Ritter 1978:50, 52). Finally, the paramount chief had several Kosraens put to death after their attack on the British whaleship *Harriet* in 1842, though his claim of executing 350 individuals (Gulick 1932:502) probably was an exaggeration to avoid British reprisal, and a total one-tenth that amount or less is more likely (Hezel 1983:115).

Despite the absence of pertinent vital statistics, it appears that mortality declined substantially after the 1870s. Occasionally deaths increased during the German and Japanese administrations--the unknown number dying in a deadly dysentery epidemic in 1901, the six killed by a typhoon in 1905, the six infants who died during a whooping cough epidemic in 1924, and the large number of deaths (perhaps more than 10 percent of the total population) resulting from successive measles and dysentery epidemics in 1927 serving as particular cases in point (Lewis 1949:42, 51). But mortality levels generally remained well under control, with the 1937 crude death rate (15.7) in the Pohnpei District of the Japanese Mandated Territory likely representative of the level in Kosrae during Japan's administration.

Mortality levels in Kosrae declined further during the American

administration, probably through the introduction of additional medical services, health care practices, and drugs previously unavailable. Age-specific death rates presented in Table 12 indicate fairly low infant mortality as well as low crude death rates for the entire population. The crude death rate for 1986 was between 6.1 and 6.5; estimated crude death rates for the years 1987 through 1989 ranged from 4.1 to 5.7 (Bureau of Planning and Statistics 1990:124, 127), indicating that low mortality has persisted. A cautionary note is in order here, however, for vital statistics tend to be underreported throughout Micronesia, with the underreporting of deaths a particular problem. Measures for the period of American administration thus probably provide a rough idea of mortality levels but undoubtedly are too low.

Fertility also has played an important role in the demographic evolution of Kosrae. Shortly after initial European contact, fertility apparently was quite high. Lütke mentioned that the proportion of children was great (1835, 1:345), and Sarfert's genealogies contain examples of individuals with large numbers of sibs (1919, genealogies III, IV, VI, and VII). But once again this situation did not last. During the mid-nineteenth century, when mortality reached extremely high levels, Kosrae fertility apparently declined to very low levels. As with mortality, we have limited reliable data available with which to measure early fertility. Nevertheless, comments by individuals present in Kosrae coupled with complementary data on the age structure of the resident population provide clues to the fertility levels reached. As noted in Table 4, information is available on the numbers of children present in Kosrae for the years 1855, 1858, and 1874. Although the term "children" is not defined precisely with respect to the ages concerned, the relatively small numbers of young persons for all three years suggest that birth rates were low. More telling is the comment made by Snow, on completing his first census in 1855, that he had noted only one infant (American Board of Commissioners for Foreign Missions 1856:191)--representing a crude birth rate of about 0.9 if this was the only live birth. In 1858 Snow counted 8 to 10 infants, cause for him to remark that this was "a hopeful feature" (*Missionary Herald* 1860:37), despite its signifying a crude birth rate of only 10.6 to 13.4. Sarfert's investigation of genealogies from the nineteenth century confirms the presence of low fertility, for several families remained completely childless and some eventually died out owing to a lack of births (1919:56).

The causes of low fertility in Kosrae are not as clear as the causes of high mortality. Deaths among persons of childbearing age, the persisting underrepresentation of women in the Kosrae population during the

nineteenth century (see Table 4), and side effects of the diseases responsible for high mortality likely all contributed to the problem. But the main cause of reduced fertility probably was venereal disease, notably gonorrhea. Although not mentioned by individuals present in Kosrae during the mid-1800s, given the frequent contact between whaling crews and Kosraen women earlier in the century, gonorrhea almost certainly was a problem (Office of the Chief of Naval Operations 1944:93; Lewis 1949:54). This disease can have devastating effects on fertility, particularly in females (Morton 1966:54-60; Bender 1975:46), as it did elsewhere in the Pacific (see Pirie 1971:203). Consistent with this argument, after whaling crews ceased to visit Kosrae, fertility began to increase (Lewis 1949:57). In contrast to gonorrhea, many of the types of cultural behavior that can reduce fertility apparently played little if any role: for example, Kosraens rarely practiced abortion (Sarfert 1919:309) and during traditional times used no form of contraception (Ritter 1978:378).

If Snow defined the category "children" similarly in 1855 and 1874, then increased natality was evident in the latter year. Certainly by 1905 fertility in Kosrae had increased substantially: more than 42 percent of the total population was younger than 15 years of age, and 24 families had four or more children (Sarfert 1919:61). Despite at least three epidemics during the 1920s and a major war during the 1940s, population growth continued throughout the Japanese administration at a rapid pace--indicating that fertility levels were able to compensate for these disruptions of normal life. By 1947, a survey of the descendants from a sample of four main families indicated that 40 nuclear families had six children or more (Lewis 1949:56)--the implication being that even more large families existed. By 1947, 43.6 percent of the residents of Kosrae were aged less than 15 years (see Table 4).

Available data indicate that the rapid population growth throughout the American administration was due in part to high fertility. The percentage of persons aged less than 15 years continued to increase, reaching 51.0 percent in 1967 before declining to about 47.0 percent in 1986 (see tables 8 and 15). Birth rates were high in 1980 and 1986, the census years for which we have data on Kosrae itself (assuming that the 1980 measures in Table 10 more accurately reflect the situation than those in Table 9), and for the three earlier census years in which Kosrae data were combined with those from the Pohnpei District. Although a slight decline in fertility is evident during the late 1980s, possibly a consequence of women desiring fewer children (with some possibly turning to

modern contraceptive methods) or being unable to find suitable mates in terms of current incest rules (Ritter 1978:379, 390-392; Ritter 1980: 764-767), the persisting rates nevertheless are high (see also Levin and Retherford 1986:17, 46, 52). Estimated fertility in Kosrae for the late 1980s indicates continued high crude birth rates for 1987 and 1988 (36.0 and 35.1, respectively), declining to 23.1 in 1989 (Bureau of Planning and Statistics 1990:124). Moreover, despite reductions in total fertility rate, because the Kosrae population features an increasing number of females of childbearing age, the total number of children born continues to grow (Office of Planning and Statistics 1989:30-31). The possible causes of persisting high fertility are several, including early marriage, close birth spacing, and improved health care that increases the likelihood both of carrying a fetus to term and of giving birth successfully. The reasons underlying the causes of high fertility--such as the influence of the church on the use of modern contraceptives or the sociocultural trend toward large families--are less clear and require additional, focused research.

During the past two centuries, mobility played a minor role in the population dynamics of Kosrae until relatively recently (see Gorenflo and Levin 1992a). Kosraen legends speak of a mobile population that visited the Marshall Islands, Kiribati, several islands currently in Pohnpei State, the High Islands of Yap, and possibly Tonga (Lewis 1949:2; Pompey 1970:1-2; Ritter 1978:292-293). Oral tradition holds that Kosraens successfully invaded Pohnpei Island prior to the arrival of Europeans, and several other Micronesian islands trace their origins to Kosrae (Ritter 1978:20-21). However, by the time of initial European contact in the 1820s, Kosraens apparently had lost their ability to sail across open ocean (Lewis 1949:2; Ritter 1978:121); the likelihood of their emigrating during this phase of Kosrae's past is extremely remote unless someone else provided transportation. The inhabitants of other island groups, such as the Marshall Islands and Kiribati, have a long history of traveling to Kosrae (Office of the Chief of Naval Operations 1944:22), but with few exceptions these trips usually consisted of visits rather than relocations. During the nineteenth century the tradition of visits from the Marshalls continued, sometimes in fairly large numbers. For example, Snow reported that about 100 Marshallese arrived for a four-month visit in the summer of 1856, ultimately returning to their home islands with several other Marshallese who had resided in Kosrae for various lengths of time (*Missionary Herald* 1857:253). People from other islands also came to Kosrae: Snow mentioned the presence of an

unknown number of Rotumans in 1857 (*Missionary Herald* 1859:96), and during the 1870s 46 Ocean Islanders fleeing drought and a "large number" of Nauruans who had staged an unsuccessful uprising on their home island also came to Kosrae (Lewis 1949:37; Pompey 1970:17; Hezel 1983:241). As depopulation continued, others came to Kosrae to capitalize on the land becoming available; the relatively large number of foreigners noted in the 1874 census probably represents such an effort, though the previously mentioned Ocean Islanders also arrived that year. A missionary school, established on Ualang in 1879 (Finsch 1893:196), led to the migration of students from elsewhere in the Pacific --primarily the Marshall Islands and Kiribati--generating increased contact with outsiders that in some cases eventually led to marriage (Ritter 1978:294, 301; Hezel 1983:210). Nevertheless, with the exception of individuals who wed Kosraens, most of the people who came from other parts of Oceania during the nineteenth century eventually had to leave Kosrae (Lewis 1949:41; Ritter 1978:293-294); their demographic impacts thus were short term and minimal.

Mobility gradually became a more important factor in the demography of Kosrae during the present century. Some immigration occurred. For example, migrant fishermen from Mwoakilloa, an atoll lying east of Pohnpei Island, established a small colony in Kosrae earlier this century (Fischer and Fischer 1957: 158). But the majority of movement in the early 1900s was from Kosrae to other places. During the German period the administration transported many Kosraens to Nauru to work in phosphate mines (Wilson 1968:34; Ritter 1978:295). The movement of Kosraens to other parts of the Pacific grew in the Japanese period, primarily to provide labor in places such as the Marshall Islands and Pohnpei Island but also to visit Japan itself. Ironically this increasing movement away from Kosrae for periods of time led to increased migration of people from other islands *to* Kosrae, primarily as the wives of Kosraen men who had married outside Kosrae (see Ritter 1978: 295-297). During World War II, Japanese military forces occupied all but one coastal village in Kosrae; the Kosraens fled, but to the remote interior of Ualang rather than to other islands (Lewis 1949:46). The late 1930s and early 1940s featured large-scale relocation to Kosrae as part of the Japanese war effort: at the end of the war, the U.S. Navy repatriated 4,523 Japanese, Koreans, and Okinawans as well as 976 people from other Pacific islands (Peoples 1985:57). The early years of the American administration marked a period of limited mobility once again. However, with increasing economic investment in the TTPI, growing educational and employment opportunities elsewhere in the Pacific, and easier means of

traveling, the movement of Kosraens to other places increased. The main destinations were Pohnpei Island, for education and employment, and the Marshall Islands (notably Ebeye Islet in Kwajalein Atoll), primarily for employment (Wilson 1968:33). From modest beginnings as a collection of temporary residences, a small Kosraen community eventually developed in Kolonia, Pohnpei, though no such neighborhood appeared in the Marshalls (Ritter 1978:299-316). As occurred earlier in the century, movement away from Kosrae eventually led to the return migration of Kosraens with foreign spouses.

Relocation of Kosraens to the Marshall Islands began to decline in the 1970s probably as a result of decreasing job opportunities on Ebeye and better ship connections to Pohnpei Island than to the Marshalls. With the advent of legislation in 1972 that provided U.S. federal funds to TTPI citizens for education, increasing numbers of students began moving throughout Micronesia (e.g., to Guam and Palau) and beyond (primarily to the United States) (Hezel and Levin 1990:48). The Compact of Free Association, adopted in 1986, provided additional legislation that affected mobility in Kosrae and throughout the FSM, enabling free access of FSM citizens to the United States and any of its territories. Guam received several Kosraens, with 136 living there in 1990 (U.S. Bureau of the Census 1992b); fewer than 30 Kosraens resided in the Commonwealth of the Northern Mariana Islands during the same year (U.S. Bureau of the Census 1992a). Because pertinent data from the most recent U.S. census still have not been released, the number of Kosraens residing in the United States in 1990 remains unknown. Most researchers argue that education and employment opportunities underlie the migration to northern Micronesia and the United States. Previous research indicated that Kosraens rarely migrate with the intent of leaving Kosrae permanently (Wilson 1968: 186; Ritter 1978:317-325); current Kosraen feelings about permanent emigration, in the wake of the Compact of Free Association and growing opportunities elsewhere, require further study.

Cultural, Ecological, and Economic Repercussions of Population Change in Kosrae

The population changes documented for Kosrae over the past 150 years were particularly dramatic even for Micronesia, a region that has experienced numerous major demographic shifts since the beginning of European contact. Population changes were accompanied by a series of developments in the Kosraen sociocultural system, particularly affect-

ing social structure and economy. It is difficult to trace many of these developments precisely. By the time that Kosrae received systematic ethnographic attention in 1880 (Finsch 1893), much of the precontact sociocultural system had ceased to exist. Moreover, other developments in Kosrae over the past two centuries complicate the study of demographic impacts. The influx of Christianity is an important case in point. Despite a relatively slow start for this new religion in the early 1850s, virtually all Kosraens eventually adopted it--in the process providing missionaries with considerable influence in many aspects of Kosraen society (Lewis 1949:89-90; Wilson 1968:31; Ritter 1978:27-30). By all accounts the church employed this influence liberally, adjusting those aspects of native cultural behavior not to its liking (Hezel 1983:316). Another development that complicates the study of demography-related changes in the Kosraen sociocultural system is the massive infusion of funds from the United States during the last few decades. Beginning with an increase in American financial aid in 1963, the emphasis of the Kosraen economy shifted from subsistence activities to wage labor. Where Kosrae residents once produced all the food they consumed, they now purchase most of their food with cash earned from jobs either directly or indirectly related to government employment (Peoples 1985). Nevertheless, despite such complicating factors, one can associate many major cultural developments in Kosrae over the past 170 years with the demographic changes experienced following European contact.

When Europeans first visited Kosrae in the 1820s, they encountered a highly structured, hierarchical society that most anthropologists would call a complex chiefdom (see Service 1971:145-169). All Kosraens were classified as either nobles or commoners (Peoples 1990:296). Within these two classes, four social strata were present: the paramount chief *(tokosra),* high chiefs *(lem fulat),* land section managers *(mwetsuksuk),* and commoners *(mwetsrisrik)* (Lewis 1949:4; Ritter 1978:15-17; Cordy 1982:103). Every individual also belonged to one of four ranked matrilineal clans or superclans, each of which in turn comprised twenty or more subclans (Lewis 1949:4-5; Ritter 1978:13). This social structure provided the basis for the functioning Kosraen society during traditional times, defining who would lead and who would follow, the relations between individuals, rights to certain resources, and so on. The three highest-ranked superclans contained both nobles and commoners, providing the leadership of Kosraen society. At the center of this leadership were titled nobles, *lem wal,* numbering eighteen at the time of

European contact (Sarfert 1919:340-341), with the highest title that of the *tokosra.*

The geographic organization of Kosrae during traditional times reflected certain aspects of the social organization. The *tokosra,* other main title holders, and their families resided on the western half of Lelu Island in elaborate compounds. Selected commoners who acted as servants to the nobility resided on eastern portion of the island (Ritter 1978: 14). The remaining commoners lived on the main island of Ualang, in scattered homesteads or hamlets along the coast within one of fifty-seven districts that extended from the interior mountains to the sea (Sarfert 1919:34). A main title holder controlled each of these districts, appointing a commoner to act as land section manager or overseer. The residents of each district on the main island were responsible for producing a surplus of subsistence goods, which in turn flowed to the noble who administered that district and, eventually, to the *tokosra* (Ritter 1978:227). The food relied upon during traditional times included breadfruit, bananas, *Cyrtosperma* (giant swamp taro), and *Colocasia* (true taro), supplemented with food from the sea (Lewis 1949: 10; Wilson 1968:32; Ritter 1978:222-225). Early visitors reported a continual flow of canoe traffic from Ualang carrying local products to Lelu Island as tribute (Lütke 1835, 1:346).

The dramatic depopulation experienced in Kosrae during the nineteenth century led to many important changes. One of the most immediately apparent was the modification of settlement patterns. During the 1820s people settled almost continuously along the coast of Ualang (Sarfert 1919:35-38). The decrease in population of 90 percent or more led to the abandonment of many individual house compounds and small hamlets. For example, along the southern portion of the island the thirty-five settlements documented by Lütke in 1827 had decreased to seven by 1880; the largest of those that remained contained only 15 persons (Ritter 1978:241-242). In the 1850s Benjamin Snow had a church built on Lelu Island, and with the growing importance of Christianity, missionaries organized the construction of three churches on Ualang. As the population in Kosrae began to grow again during the late nineteenth century, people aggregated around these churches, thus creating three nucleated villages on the main island where none formerly existed to accompany the village on Lelu Island (Ritter 1978:242-243). The abandonment of farmsteads continued over the first half of the twentieth century (Lewis 1949:58), in part as a response to the organizational strategies of the foreign governments that administered Kosrae. For

example, the Japanese promoted this geographical organization by defining four administrative districts named after the main village in each--an organization subsequently adopted by the TTPI administration and persisting (with the addition of Walung Municipality) to the present. Modern Kosraens consider the area outside villages to be hinterland and rarely live there, though settlement along major roads on Ualang began as early as the 1970s (Ritter 1978:275-288).

The system of land tenure also changed dramatically with the demographic evolution of Kosrae. The first European visitors believed that the *tokosra* ultimately owned all land and gave the rights to administer certain districts to selected main chiefs (Lesson 1839, 2:488-499; Lütke 1835, 1:346; Kittlitz 1858, 1:355). However, rapid depopulation caused two changes: noble lines died out, providing fewer administrators, and a decreased number of inhabitants meant that more land was available for the remaining residents. Although some researchers argue that depopulation enabled commoners to emerge from a landless past (e.g., Lewis 1949:74), others suggest that commoners had certain rights to land during traditional times that persisted, with some modifications, through the period of depopulation (Ritter 1978:228-231). A lack of detailed accounts of precontact land tenure patterns makes it impossible to determine the degree of change in land tenure. Nevertheless, developments clearly occurred in the form of commoner land rights and in the means of conveying these rights to future generations. For example, the adoptive relationships that increased with depopulation emerged as important means of determining inheritance (Ritter 1981a:57). As population grew throughout the twentieth century, Kosraens divided and redivided land parcels to provide for growing numbers of heirs (Ritter 1978:234-235). Foreign administrators once again contributed additional developments, the most dramatic example being the Japanese appropriation of land in the Ualang interior based on the erroneous belief that it belonged to nobody (Lewis 1949:45; Ritter 1978:236; Peattie 1988:98).

One of the most important consequences of depopulation in Kosrae was change in social structure. Once again, detailed data are not available for all sectors of society. However, one can gain some appreciation of the disruption in this centralized, hierarchical society by considering the changes that occurred among noble ranks. As noted above, Kosraen society featured eighteen titled nobles at the time of European contact. By 1869 only eight titles remained. Researchers noted five remaining noble titles in 1880, decreasing to three by 1910 and to two by 1960, the

remaining titles having lost most of their original meaning (Wilson 1968:27-29). The causes of these changes probably were several, not the least of which was the church's interest in eradicating the social inequality that dominated traditional Kosraen society (in part, no doubt, to increase its own authority). But the removal of large numbers of people through depopulation, some either holding high office or in line to inherit such an office, undoubtedly opened the way for alternative administrative strategies to emerge. As early as 1874 Kosraens began selecting their leaders by popular vote, and although Kosraens today are proud of descent from noble lineages, such genealogical position has little effect on the working of modern society (Peoples 1985:35). Disruption of social structure expanded beyond the nobility, and entire subclans died out during the same period (Hezel 1983:167). Today Kosrae State is ruled by individuals democratically elected to office, with minimal appeal to past social structure. Kinship in general continues to play an important role in terms of determining patterns of inheritance and obligation. But the modern kinship system no longer relies on the traditional clan structure, which the Kosraens largely abandoned by the early twentieth century, emphasizing instead simple consanguineal or affinal relationships (Peoples 1985:127-128).

Change in population coupled with other developments eventually led to shifts in the economy of Kosrae. During traditional times the native economy focused on subsistence, emphasizing agricultural productivity with marine resources providing supplemental sources of food. Tribute in the form of food flowed up the social hierarchy, with commoners growing and collecting sufficient surplus to sustain the non-food-producing nobility. The tribute system changed with depopulation, largely as a consequence of fewer commoners producing food and fewer nobles claiming the surplus (see Hezel 1983:241), and by the early 1900s tribute to chiefs had ceased entirely (Lewis 1949:74; Ritter 1978: 228). Nevertheless, with the exception of a few years during the Japanese administration, when maturing coconut groves planted during the German period boosted cash income from copra sales (Lewis 1949:45), Kosrae maintained a subsistence economy into the early 1960s (Wilson 1968:32). With a substantial increase in American funds flowing toward the entire TTPI during the early 1960s this situation changed substantially (Peoples 1986:104-105). A cash economy soon followed. As a result, most of the current work force in Kosrae State earns wages. The majority (62 to 65 percent during the late 1980s) of the state work force are employed by the federal or state governments (Bureau of Plan-

ning and Statistics 1990:93), with most of the private businesses in the state ultimately relying on this source of funds as well (Peoples 1985: 21). Ironically, in a period of expanding population and growing pressure to provide for this population, increasingly few people exploit the agricultural and marine resources of Kosrae, relying instead on cash income and the purchase of imported food (Peoples 1986). As a result of these economic changes, Kosrae State's food imports totaled US$1.3 million in 1986, growing to nearly $1.6 million in 1989 (Bureau of Planning and Statistics 1990:6)--adding to a trade deficit that ranged between $4.6 million and $6.8 million over the same period (Bureau of Planning and Statistics 1990:27).

Despite the demographic and cultural upheaval experienced in Kosrae over the past two centuries, ecological impacts have been minimal. However, with increasing pressure to provide for a rapidly growing population, such impacts may soon emerge in the form of various development strategies, such as the promotion of commercial agriculture. The belief in Kosrae's agricultural potential has a long history. Early visitors commented on Kosrae's rich agricultural potential, how high yields were possible with minimal work (Kittlitz 1858, 1:369). Subsistence agriculture always has been an alternative in Kosrae, surviving dramatic demographic and cultural changes, a major war, and several foreign administrations with vastly different development goals (Lewis 1949:68-69). As discussed earlier, during traditional times commoners were able to grow and collect enough surplus food to support a fairly large noble class who produced no food themselves. Currently the inhabitants of Kosrae do not produce enough food to feed the state population, but this is a consequence of underexploiting the state's agricultural potential: individuals engaged in wage labor have less time to tend fields than those employed otherwise (Peoples 1985:71-73, 83-84; Peoples 1986:105), and increasingly nucleated settlement means that fewer people live near their farm plots (Lewis 1949:58). To meet the needs of a growing population, the possibility of increasing food production as a means of developing the state economy represents an important potential strategy for planners (see Office of Planning and Statistics 1985:141, 150-151; Office of Planning and Statistics 1992:117-118). But much of Kosrae State is mountainous and covered with forests, the foot slopes, alluvial fans, and bottom lands most suitable for agriculture comprising only about 15 percent of the total land area (Soil Conservation Service 1983:1). Because of drainage problems, fertility limitations, steep slopes, and potential erosion, much of the state does not lend itself to large-scale mechanical clearing of land and commercial agriculture

(Soil Conservation Service 1983: 15). Although Kosrae can produce much more food than it currently grows, possibly enough to feed its large population, it is unlikely that a commercial agriculture sector will provide a sustainable development alternative.

Conclusions

In a region where dramatic population changes have been almost commonplace over the past two centuries, Kosrae emerges as the part of Micronesia with perhaps the most turbulent demographic history. Following depopulation in the first years of the nineteenth century due to a typhoon and civil war, diseases introduced from outside Micronesia decimated the remaining native population--with one illness increasing mortality and another reducing fertility. In conjunction with continued civil unrest and tropical storms, diseases reduced the Kosrae population to a minimum of about 300 persons in 1880, only 5 to 10 percent of what it was eight decades earlier. Later in the same century, mortality came under control and fertility began to increase. The resulting population growth began in the last decades of the 1800s and continued into the present century, producing a de facto 1986 population greater than any previously documented. The demographic changes were dramatic, first nearly emptying the archipelago of inhabitants and then adding more than it may ever have known. The native cultural system adapted accordingly, modifying social structure, the economy, and other facets of shared behavior in response to the vastly different challenges that it faced. Additional cultural changes occurred as a result of intense missionary activity. Because of these developments and those that followed in the present century, the sociocultural system of modern Kosrae State bears minimal resemblance to that of pre-European times.

Because cultures constantly evolve, a certain amount of change is likely to occur in any sociocultural system. But with the removal of most practitioners of traditional culture and the exposure of the remaining inhabitants to the pressures of several influential non-Micronesian forces, the Kosraen system was readied for substantial modifications. Since many of the sociocultural developments that occurred were dramatic, occurred over a short period of time, and in some cases were promoted by foreigners, they were generally adopted without going through the selective processes that adjust systems and help to produce successful adaptive strategies. The resulting situation is not necessarily all bad. For example, Kosraen culture probably accommodates what have become inevitable modern innovations, such as Western forms of

government and a cash economy, more readily than do more traditional sociocultural systems in Micronesia. Moreover, because Kosrae possesses relatively rich natural resources compared to much of Micronesia, it is possible that many changes in the sociocultural system have a greater chance of success there than elsewhere in the region.

Like the rest of the FSM, Kosrae State has come to rely heavily on economic assistance from the United States. Depopulation and culture change long ago cut ties with past systems, greatly limiting the degree to which Kosraens can appeal to the successful adaptive strategies of their ancestors. As the Kosrae State population continues to grow, the prospects of developing a sustainable economy and some measure of independence becomes increasingly remote. Providing a feasible explanation of the current situation in terms of a tumultuous demographic history is the easy part. Developing a means of curbing population growth and devising development strategies that enable this small state to achieve a sustainable economy, either independently or in conjunction with the other states of the FSM, is a much greater challenge.

NOTES

Janice Goldbloom, of the National Academy of Sciences Archives, made available rare reference materials central to this study. Diane LaSauce kindly donated her editorial talents to help produce the final version of the manuscript.

1. In the interest of clarity and consistency, I follow modern conventions and use the term “Kosrae” or “Kosrae State” to denote the archipelago in the Federated States of Micronesia currently designated by the latter name. Throughout the article I refer to the five subdivisions of Kosrae State as “municipalities,” although as political jurisdictions these areas are a product of twentieth-century colonial rule; whenever possible, I distinguish between Tafunsak and Walung municipalities--the latter once a part of the former. Finally, I employ currently accepted spellings for all geographic areas discussed--opting for “Kosrae” and “Pohnpei,” for example, in place of “Kusaie” and “Ponape”--regardless of the time period concerned.

2. Ritter (1981b) invested considerable time examining the topic of Kosrae population at European contact. Through reexamining data collected in 1827 (Lütke 1835, 1:343-345) in which he accounted for omitted portions of Kosrae and added the likely number of resident children, Ritter concluded that the population at contact was between 2,522 and 3,442, with 3,000 as a best estimate (1981b:21).

3. Sarfert estimated that the population of Kosrae reached a minimum of about 200 persons by 1879 (1919:49). Finsch estimated a population of less than 200 in 1880, decreasing to about 80 persons in 1890 (1893:195-196). Lewis concurred that a minimum of 200 was possible in 1880 but that population began a period of steady increase shortly thereafter (1949:49). In contrast, after a careful study of this topic, Ritter concluded that a minimum

of about 300 in 1880 was likely (1978:55). I am inclined to agree with the latter estimate because of its greater feasibility. First, evidence of increasing fertility during the 1870s, such as that found in an examination of pertinent genealogies (Sarfert 1919:56), would have reduced the rate of depopulation during that decade in the absence of increasing mortality or emigration--two trends for which there is no evidence. Following the census of 1874, a decrease to 200 persons by 1880 would have required an average annual decline of more than 12.1 percent, approaching or exceeding the depopulation rates when (as discussed later) disease was rampant and fertility extremely low. Second, the average annual growth rate of nearly 3.9 percent necessary to reach the census-documented total of 516 persons in 1905 from a population of 200 in 1880 is highly unlikely for a people coming off decades of pronounced population decline; the average annual growth rate of 2.2 percent required to increase from 300 to 516 persons over a twenty-five-year period is much more feasible.

4. The date and precise results of the fourth missionary census of Kosrae are uncertain. Another missionary who visited Benjamin Snow cited the following entry in Snow's journal: "Dec. 29, 1860. Finished taking the census today. I make 748 in all--523 in Ualan [Ualang] and 225 in Lila [Lelu]" (Damon 1861:42). A report dated 2-5 October 1860 cites Snow's demographic research as follows: "The population of Kusaie [Kosrae] is diminishing. The number early in 1859 was 747, which was 82 less than in the preceding year" (American Board of Commissioners for Foreign Missions 1860:135). Finally, a quotation from one of Snow's own letters (dated 8 January 1859) reads: "I have just taken the census and find that the population is 82 less than last year. Seven hundred and forty-seven is the number of people (natives) now on the island" (*Missionary Herald* 1860:37).

Given the demographic changes experienced in Kosrae during the 1850s, it is unlikely that two censuses conducted in consecutive years recorded about the same number of inhabitants; one census is much more probable. Although the two possible totals vary only by one, I am inclined to accept 748 as the correct figure: the geographic breakdown (Ualang versus Lelu) and age breakdown (see Table 4) both support this figure, and 748 is "82 less" than the total of the preceding census. A date of 1858, in turn, probably is correct --given Snow's letter of 8 January in which he wrote that he "just" completed the census (thus presumably placing the census in early 1859 or late 1858) and his comparison to the census of "last year" (most likely 1857). Note that both of the 1860 references cited above concern a letter that *precedes* the December 1860 date cited by Damon (1861:42), arguing that Damon had erroneously copied the date from Snow's journal. As an aside, Sarfert apparently recognized these inconsistencies with the fourth missionary census, reporting 748 persons for "1858/59" (1919:48, 54).

5. Because the primary aim of this study is to explore demographic change in a functioning sociocultural system, it focuses solely upon the Pacific Islanders residing in Kosrae for 1920, 1925, 1930, and 1935. The number of Japanese residing within parts of the Mandated Territory varied dramatically over the three decades that Japan controlled the area. The Japanese government regulated the migration of Japanese nationals to its Micronesian islands, promoting increased immigration to many of these islands for commercial or military purposes during the 1930s. Because considering these *imposed* in-migrants would cloud our understanding of demographic evolution within Kosrae, I focus on Pacific Islanders during the Japanese period of administration. Although the Japanese also promoted the migration of nearly 1,000 persons to Kosrae from elsewhere in the Pacific (Peoples 1985:57), this in-migration probably occurred shortly before and during World War II, and thus most would not appear in the last (1935) Japanese census.

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