The Population of Kosrae at Contact

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Abstract—This paper focuses on the contact population of Kosrae, the easternmost island of the Caroline chain. The historical material concerning Kosrae is sufficient to allow a fairly careful evaluation of the contact population estimates. The most important source of information consists of the explorer Lütke's attempt to enumerate the adults of the various districts of the island. By determining and correcting for the likely errors in his count, it is possible to derive a range within which the contact population must have fallen. The results suggest that most estimates of the Kosraen population at contact tended to be low rather than high, and it appears that there was considerable depopulation in the thirty years between contact and the first missionary censuses. Nevertheless, Kosrae was sparsely populated in comparison to other similarly sized islands. This situation is partially explained by evidence that there was considerable depopulation shortly before European contact. This case illustrates that one cannot assume that any specific precontact Pacific population was characterized by either population equilibrium or a tendency toward an optimum size.

Introduction

Anthropologists and demographers long believed that Pacific island population decline was the inevitable result of contact with Europeans, and considerable effort was directed toward explaining what was seen as a universal phenomenon. Despite some well documented cases of depopulation, this view has come under increasing attack (e.g., McArthur 1968, 1970). Much of the earlier evidence for depopulation was found to have been derived from comparing inflated initial population estimates with later counts (McArthur 1970 : 1099). The task of the researcher interested in Pacific island populations has shifted from explaining the universal to explaining the variation; and as part of understanding that variation we need additional and more careful assessments of contact population sizes and dynamics. But McArthur (1970: 1101) has warned of the futility of working with most of the estimates of early historical population. An examination of the population estimates for Kosrae Island at contact does indeed raise many questions about their accuracy. But fortunately, there is enough detailed historical information to allow an assessment of those estimates and to determine a reasonable range within which the contact population must have fallen. In this paper, I attempt to derive such a range, making clear the assumptions used in the process. In so doing, I find that the population estimates made by the first European visitors tended to be low rather than high, and I show that Kosrae represents a clear case of massive depopulation.

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Kosrae Island

Kosrae, also known as "Strong's Island" and "Kusaie," is a high volcanic island of approximately 42 square miles in the Eastern Carolines of Micronesia. Although the island may have been sighted as early as 1529 and was definitely seen in 1804 (Sarfert 1919 : 1), the first known contact between Europeans and Kosraens did not occur until 1824. At that time, the French exploring vessel, the COQUILLE, captained by Louis Duperry, stopped at Okaht Harbor for ten days. The Russian ship SENYAVIN, captained by Fedor Lütke, was the second European vessel to visit the island. It also anchored in Okaht Harbor and stayed for three weeks in 1827 and 1828. Both of these vessels were engaged in scientific expeditions, and the accounts resulting from their stays provide valuable information about Kosrae at contact. The most important description of the first voyage is that of R. Lesson (1839), the medical officer of the COQUILLE. Captain Duperrey (1828) and his officer Dumont d'Urville (1835) provided shorter accounts. The second stopover was described in detail by Captain Lütke (1835) and the naturalist Kittlitz (1858). All except Kittlitz offered population estimates of the island, but Lütke's attempt to enumerate the adults of the various Kosraen districts provides the most important source of information about the contact population.

The Early Population Estimates

The first Europeans to visit Kosrae reported that the island was sparsely populated. Duperrey (1828 II: 637) estimated a population of about 2,000 people, while Dumont d'Urville (1835 II: 461) believed there were "no more than two or three thousand." Lesson (1839 II: 493) provided an even lower estimate. He wrote:

> The island of Oualan [Kosrae] is in general little peopled, and I was not able to determine the laws which keep the population so low, whether it is some vicious institution which orders child sacrifices upon the death of a chief, or whether it is due to the unhealthiness of the place. This last supposition is the least likely, as we met a large number of old people, male and female. The big village of Lele [Leluh], the most highly populated place on the whole island, has a population of 500 to 600 people. The rest of the island consists of only three or four huts in a cluster, or even solitary houses, spread out on the edge of the sandy shores and in the interior valleys. One cannot be far from the truth in estimating the whole of the population to be, at the most, 1200 people.

When Lütke visited Kosrae three years later, he attempted to obtain a head count of the island. His chief informant, Kaki, the headman of *Lacl* district, helped Lütke prepare a list of the districts of the island along with the number of adults in each. Thus, Lütke obtained a total of 709 adults, not including titled chiefs, district

headmen ("chiefs of the second class"), or their wives. From this information, he (1835 I : 345) estimated the total population to be 800 "without counting the children, whose number is proportionately very high."

Lütke's list provides the most detailed information about the contact population, but even his revised estimate appears to be too low. Kittlitz, the naturalist on Lütke's ship, spent much time visiting the districts around Okaht Harbor. He acknowledged the accuracy of Lütke's counts for the three districts of *Lacl, Finohlohf*, and *Lacs*, but he questioned the total for *Okaht* district. Kaki had listed his own district of *Lacl* as the most populous on the main island, but Kittlitz claimed that he always found considerably more people in *Okaht*. "It is likely that errors or misunderstandings have crept into the information of the good, very informative Iros Kaki of Lyal.... This casts doubt on the fairly low total, derived from summing all of the individual village populations" Kittlitz(1858 II : 9).

Following his stay on the island in 1910, the German ethnographer Sarfert reviewed the early literature and concluded that Lütke's estimate was too low because Lütke had apparently missed 14 of the traditional districts. Sarfert (1919 : 49) then concluded that Duperrey's estimate of about 2,000 people was probably correct. This figure of 2,000 has been repeated and become well established in the literature on Kosrae (Lewis 1949 : 59, 1967 : 6, Wilson 1968 : 21).

However, an examination of the discrepancy between Lütke's totals for settlement on Leluh islet and even the most conservative estimates by the other early explorers suggets that although the figure of 2,000 is possible, it is probably still too low. The contact population was more likely between about 2,500 and 3,500 with 3,000 being a reasonable estimate. This number is higher than most estimates of the contact population but overlaps with Dumont D'Urville's estimate of 2,000 to 3,000 people. Table 1 summarizes the estimates of Kosraen population at the time of the first European contacts.

Table 1. Kosraen contact population estimates.

Year	Population Estimate	Source
1824	2,000	Duperrey (1828 II : 637), captain of the COQUILLE, the first European ship to visit Kosrae. Spent ten days, mostly at Okaht Harbor on the west coast, but also walked to Lelu island on the east coast.
1824	1,200	Lesson (1839 II : 493), the medical officer on Duperrey's voyage. Also walked to Lelu island.
1824	2,000–3,000	Dumont d'Urville (1835 II : 461), Duperrey's second officer. Also walked to Lelu island.
1828	800 adults	Lütke (1835 I : 344), the captain of the SENYAVIN, the second European ship to stop at Kosrae. Spent three weeks camped at Okaht Harbor and made a trip to Lelu.

Table 2. Lütke's enumeration of the adults on Kosrae in 1828

District Name in Original	Probable District Name in Modern Orthography*	Males	Females
MAIN ISLAND			
1. Limaisse	Limes	2	3
2. Pétak	Puhtuhk	6	4
3. Pghijik	Pihkuhsrihk	8	7
4. Siélat	Sialat	10	7
5. Ouïa	Wiac	9	6
6. Matanté	Muhtuhnte	18	9
7. Taüyenziak	Tahfuhnsahk	3	2
8. Tépat	Topat	10	8
9. Lual	Lacl*	20	15
10. Ouégat	Okaht	10	14
11. Founolof	Finohlohf*	2	2
12. Liasse	Lacs	10	8
13. Ueule	Yacl*	5	3
14. Yela	Yela	11	8
15. Ouïo	Wiyac	12	10
16. Linmout	Lenwot	9	6
17. Mot	Wot	10	7
18. Léap	Leahp	7	6
19. Kioche	Koasr	6	4
20. Lighinlelem	Lihkihnluhlwem	8	6
21. Ouai	(Facl)we	4	3
22. Tahoëne	Tahfowan*	5	3
23. Icha	Israc	8	6
24. Nevoalil	Nefalil*	7	6
25. Sulmoyen	Selmeoa* (Sipien?)	6	5
26. Outouai	Utwac	10	7
27. Tamoout	Tahfeut*	5	4
28. Meenké	Menke*	7	5
29. Yeoungal	Yewal	5	4
30. Téaf	Tacf	6	5
31. Founkol	Finkol	13	7
32. Keplé	Kuhpluh	8	6
33. Léla	Lela	5	4
34. Yeseng	Yeseng	6	4
35. Méalem	Maclwem	6	4
36. Piliul	Pilyuhul	13	8
37. Peuk	Puhk	(no counts obtained)	
38. Tenoag	Tenwak	8	5
39. Sianjik	Sacnsrihk	7	5
40. Taoeyat	Tahfeyat	8	6
41. Toouol	Tofol	9	6
42. Ninnem	Innem	9	7
43. Lougaf	Lukacf	4	3
44. Fouornceng	Fohmseng	6	4
TOTAL MAIN ISLAND		341	252

LELUH ISLAND				
1.	Lik	Lihk	6	5
2.	Siaouaïr	Safair	10	15
3.	Ninfouial	Infacl	14	5
4.	Métais	Metais	5	4
5.	Tai	Te	20	10
6.	Yat	Yat	13	9
TOTAL LELUH ISLAND			68	48
TOTAL KOSRAE			409	300

DISTRICTS NOTED BY SARFERT BUT NOT IN LÜTKE'S COUNT			
1.	Jušon	Yesron	
2.	Senkoša	Senkosra*	
3.	Sipien	Sipien	(or possibly Selmeoa)
4.	Jemelil	Yemuhlihl	
5.	Sakšo	Sahksro*	
6.	Potak	Puhtuhk	
7.	Malso	Maclsuh	
8.	Finauenpis	Finaunpes*	
9.	Lola	Lela*	(Loal*?)
10.	Ša	Sre*	
11.	Šuoš	Sruwusr	
12.	Ka	Kwe	
13.	Matanluk	Muhtuhnlihk	

Sources: Lütke 1835: 343–45; Sarfert 1919: 35–38, 47–48; Lee 1976; Wilson 1968: 51–60; Field Notes.

*Note: In a number of cases the accuracy of the transcription into modern orthography is in doubt.

An Evaluation and Revision of Lütke's Estimate

Lütke (1835: 345) himself recognized the possibility of underenumeration in the figures he obtained from Kaki, and he corrected his figure of 709 adults upward to an estimate of 800. Two basic kinds of errors are likely to have occurred as Kaki sat with Lütke in Okaht Harbor attempting to recall the number of men and women in each of the many traditional districts: (1) errors in Kaki's knowledge and recall and (2) errors in communication between the Kosraen and the Russian. The former type of error included the omission of entire districts as well as understating the number of adults of some districts. The second kind of error would include misunderstandings over whether certain status groups or age categories were included in the count.

Table 2 gives Lütke's totals of the adults from the various districts on Kosrae in 1828 and lists the names of the additional districts noted by Sarfert. Figure 1 shows the general location of the traditional districts. By varying assumptions about unknown errors, it is possible to derive a probable range for the contact population.

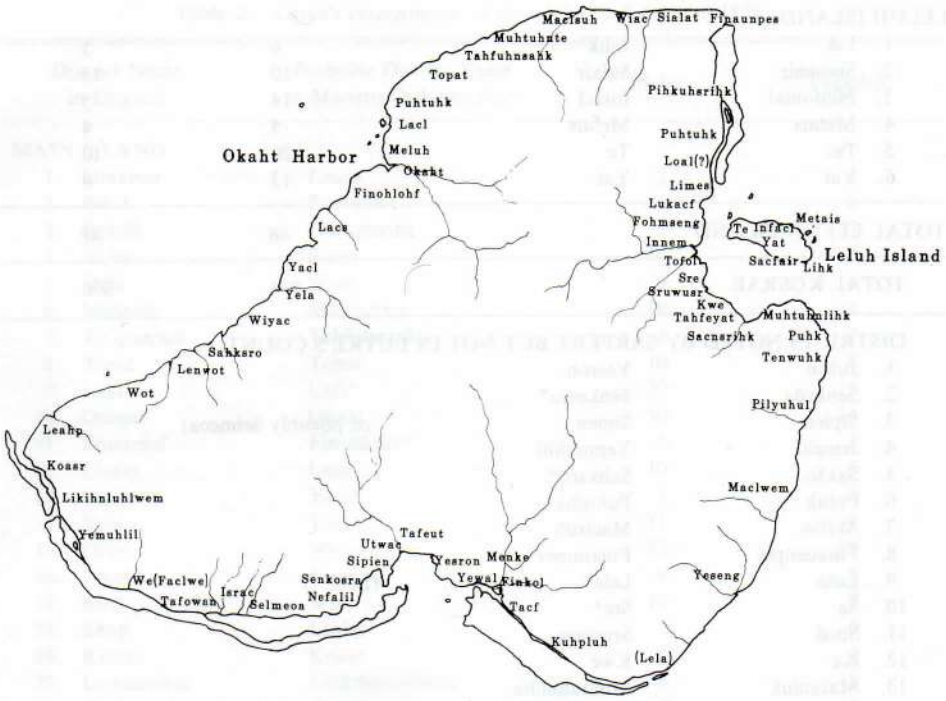

Fig. 1. Traditional Kosraen districts. The sources are Sarfert (1919), Lee (1976), Wilson (1968), Hawaii Architects and Engineers (1970), and field notes. The modern spelling of the names of some districts is uncertain.

Table 3. Corrections to Lütke's count.

	Maximum	Liberal	Conservative	Minimum
Correction for Underenumeration of Adults	2,251	1,497	1,223	979
Correction for Omitted Districts	2,835	1,721	1,391	1,035
Addition of Children	5,063	3,442	2,522	1,631

In this section, I derive such a range by calculating four estimates, which I refer to as the maximum, the liberal, the conservative, and the minimum possible populations. Table 3 summarizes the calculations.

Correction for Underenumeration Within Lütke's Districts

The first step is to estimate the number of individuals not included in those districts that Lütke did enumerate and to add them to his count. The discrepancy between Lütke's total for the six districts of Leluh island and the other estimates of

the Leluh population offer a starting point. Lütke's list shows 116 adults for the island of Leluh, not including chiefs and their wives. But when Lesson (1839 II : 481) had visited Leluh, less than four years before Lütke, he described the "entire population" gathering at a communal meeting house as consisting of 300 men and, standing apart, about 200 women "not counting children." It is probable that all or nearly all of these approximately five hundred adults were Leluh inhabitants, as there appears to have been no prior announcement of the impending arrival of Lesson (which might have allowed the curious to gather from nearby districts). The next day, when Dumont d'Urville (1835 II : 459) visited Leluh, he found "... on the beach, the entire population of Leilei, numbering at least 800 people, assembled to witness our arrival." In the passage quoted above, Lesson estimated the population of Leluh to be 500 to 600 people. Thus, we have three rough figures for the population of Leluh from the first European ship: 800 people, 500 to 600 people, and 500 adults. Certainly, these figures make Lütke's count of 116 adults seem low.

There are three reasonable explanations for the discrepancy between Lüke's count and the estimates of those on the first ship. Lütke and Kaki's count specifically did not include "chiefs" and their wives. Although Lütke apparently believed that only about twelve titled chiefs lived in Leluh, Kaki may have omitted numerous other nobility (*lwem*) who did not actually hold titles. A second reason for the discrepancy might be different definitions of "adulthood." Lesson's rough count of 500 Leluh adults may have included many who were not counted by Kaki as adults. The third possibility is that Kaki forgot many Leluh people when he made his enumeration. Leluh was densely populated, and it is likely that Kaki, living near Okaht Harbor on the other side of the island, would not have been able to recall everyone. Kittlitz questioned Kaki's count of the nearby district of *Okaht*, and there was an even greater likelihood of underenumerating the more distant and populous districts of Leluh. Whatever combination of the above causes, Lütke's count appears too low.

If we accept that there actually were 500 "adults" (however defined by Kaki) in Leluh, Lütke's count of about 143 (including the chiefs and their known wives) is slightly less than 30% of the actual total. It is quite unlikely that his enumeration of the entire island is too low by the same factor. His knowledge of *Lacl, Lacs*, and *Finohlohf*, and Kittlitz's testimony both suggest that at least the counts of those districts are accurate. But if we assume that his count of the rest of the districts of the island only included about one third of the actual number of inhabitants, the corrected figure for the adults of the enumerated districts would be 2,251. Although this figure is clearly too large, it can serve as a theoretically possible maximum.

By assuming that 100 of the Leluh "adults" seen by Lesson would not have been considered "adults" by Kaki, we can obtain a more probable, but still liberal estimate. Then Lütke's count of about 143 is less than 40% of the real total. Let us assume that except for *Lacs* and *Lacl*, Kaki underestimated the larger main island districts (defined as those with more than ten adults in Lütke's count) by 50%. Recall that Kittlitz thought there were "considerably" (*betrachtlicher*) more people in Okaht than in *Lacl*; but Lutke listed the former as having about 30% less people than the

latter. Thus, 50% is on the high side but not an unreasonable figure for the underenumeration of *Okaht*, and we would expect greater underenumeration for districts farther from *Lacl*. This assumption leads to a liberal estimate of 1,497 adults.

If Leluh were underrepresented largely by the exclusion of the untitled *lwem* nobility and if those districts besides *Lacl* and *Lacs* with populations over ten adults were underenumerated by about 25%, and again assuming about 100 of the Leluh people Lesson observed were not of adult status by Kaki's usage, we obtain a total of 1,223 adults. This estimate is conservative but not unreasonable.

It would be difficult to justify a lower estimate. But for the sake of establishing a minimum possibility, let us assume that Kaki was absolutely correct in his recall of the number of people in the various districts (and that Kittlitz was wrong about *Okaht*). Then we must assume that most of the extra people in Leluh were nontitled nobility who were not counted by Kaki, and even though the 709 figure may be correct for commoners, the addition of nobility would raise the total to considerably more than 800. Assuming that only 300 of the 500 Leluh people observed by Lesson were really adults in Kaki's calculation, we obtain 979 adults for the districts enumerated by Kaki.

Thus, we have four estimates: 2,251; 1,497; 1,223; and 979 for the maximum, liberal, conservative, and minimum likely number of adults in the districts enumerated by Lütke at the time of contact. This range is wide, but it should be obvious from the way the figures were derived that an estimate between 1,223 and 1.497 is most reasonable.

Correction for Omitted Districts

Lütke (1835 I : 344) himself wrote "the names of some villages which we came upon are not mentioned in this table. Perhaps they were forgotten, or perhaps Kaki did not designate the villages separately but the surrounding areas only." In 1910, Sarfert noted the names of 13 districts which were not listed by Lütke. An additional district was listed by Lütke, but with a note saying that no population figures were obtained. Thus, there are 14 districts in Sarfert's list of 57 main island districts which are not enumerated in Lütke's table (see Table 2 and Fig. 1 above). Although Lütke suggested that the missing "villages" (i.e., districts) might have been included in surrounding districts, Sarfert believed it more likely that they had been forgotten. Most of Sarfert's additional districts are still independent sections in modern Kosrae despite some merging of other districts (Wilson 1968 : 60), and it is unlikely that many of them could have been considered part of other districts.

One might argue that the districts left out by Lütke were probably unpopulated (the possibility of depopulation prior to contact is considered below). However, there is evidence that at least some, if not all, of the missing districts supported populations at contact. Lütke had noted that the population of one district was not obtained; and Lesson lists four districts not mentioned by Lütke. Two more of the districts are known to have been the homes of ancestors of today's population, and one of those appears on Duperrey's (1826, Atlas II) map.

If Kaki were totally random in his forgetfulness (i.e., the districts he forgot were more or less equally populated with the ones he remembered), then nearly 25% of the population of the main island is missing. Using the improbable maximum estimate, we then obtain a total of 2,835 Kosraen adults at contact. However, it is more likely that many of the districts which Kaki neglected had smaller populations. Assuming that the 14 missing districts averaged 14 adults each (less than two-thirds of the 23.5 average number of nonchiefly adults per main island district obtained for the liberal estimate above) leads to a modified liberal estimate of 1,721 adults. A more conservative estimate of 1,391 is obtained by assuming that the missing districts averaged only ten commoner adults each. To derive a minimum estimate, we might assume that the missing districts were all rather unimportant with half unpeopled and the remaining averaging only six adults each. Then we derive a theoretical minimum of 1,035 adults. Thus, for the entire island, we have estimated the number of adults at contact to have been between 1,035 and 2,835 with the likely range between 1,391 and 1,721.

Addition of Children to Population Totals

The final step in this exercise is add children to these figures to estimate the total contact population. The first problem, already alluded to, is to determine which age groups Kaki considered "adults." In modern Kosrae, the transition from a 'youth' (*mwet fasr*) to an 'adult' (*mwet mahtuh*) does not occur until about age 30, although behavior and other factors will influence exactly to which category individuals are said to belong. These same categories existed aboriginally (Lesson 1839: 492) and probably were applied roughly as they are today. Thus, depending on how well Kaki and Lütke communicated, the enumeration may only have included 'full adults.' Or it may have included all those who had reached puberty, i.e., all except 'children' proper (*tuhlihk*). However, even if Kaki meant to include youth in his count, it is likely that he would have forgotten them more often than 'full adults.' Even today, middle-aged Kosraens are unlikely to have knowledge of all *mwet fasr* residing in other villages, although they usually know all of the mature adults.

Even if we knew the exact ages included in Lütke's figures, the age structure of the Kosraen contact population remains unknown. The only statements which relate directly to the age structure are those of Lütke (1835 I: 345), who noted that the proportion of children was very great, and of Lesson (1839 II: 493), who said that many very old people of both sexes were seen. Lesson (1839 II: 486) also noted that women appeared to marry very early. Sarfert's genealogies suggest that large offspring sets were common enough as were couples with few or no children. For example, the man who became the paramount in 1837 had eight siblings who survived to adulthood (Sarfert 1919: Genealogy III). Genealogies collected in 1975 indicate that early contact commoner sibling sets also could be quite large. Thus, large offspring sets did occur although, as we might expect, fertility was probably highly variable. Since the age structure of a population is mainly a function of fertility (Coale 1964), we would expect the proportion of children to have been high but not

extremely high by modern standards—i.e., the proportion under 15 would not have been as high as 40%.

One other factor affecting the contact population structure must be noted: the high sex ratio. In Lütke's table, men outnumber women nearly three to two. We might speculate that Kaki, as a male, forgot women more often than men. However, the missionary censuses show the same disproportionate sex ratio in the 1850s. This sex imbalance has often been noted but never explained (Sarfert 1919 : 53–54, Lewis 1949 : 63–64). Sarfert's informants claimed that infanticide had never occurred on Kosrae, but it is possible that preferential care given to male infants resulted in lower male infant death rates (Hunt et al. 1949 : 35 noted such a phenomenon on Yap). Given the same fertility rates, the large number of "excess" males (20% of the adult population) would result in a lower proportion of children.

The data and model life tables presented by Weiss (1973) for "anthropological" populations suggest that, after subtracting the 20% of the adult population who were "excess" males, the proportion of Kosraens who were not adult could have ranged from between about 40% to 60% of the population. But we must reconcile any assumptions about the proportion of children with the earlier assumptions made concerning the proportion of the Leluh population considered adult by Kaki. For the maximum estimate of 2,835 adults, we assumed that 500 of the Leluh people were adults in Kaki's usage. If we take Duperrey's estimate of 800 total people in Leluh and, to continue maximizing, assume that there were another 100 children whom he did not see, the number of Leluh children would be 44% of the total population, or about 50%, when we exclude the nonreproducing males. This number is within the expected range. Assuming the ratio of children to adults was about the same for the entire island, we would then obtain a theoretical maximum total population of 5,063.

For the liberal estimate, we assumed that there were 400 'adults' in Leluh. If Leluh had about 800 people total, approximately 50% of the population (and 56% after excluding the excess males) would have been children. Again assuming this ratio held for the entire island, the number of Kosraens would be 3,442.

When making our conservative estimate, we also assumed that 400 people in Leluh were adults. If we reduce Duperrey's Leluh estimate to 700, children would comprise nearly 45% of the population, thus leading to a corrected total of 2,522 Kosraens.

To derive the minimum estimate of 1,035 adults, we assumed that only 300 people in Leluh were adults. Using Lesson's lowest estimate of 500 Leluh people—an estimate that is probably much too low, given that his estimate of 1,200 for the entire island is clearly too low—the proportion of children in Leluh's population is 40% (or 48%, excluding the nonreproducing adults). Assuming that, because of lower birth rates among commoners, the percentage of children was only 35% on the main island, we derive a minimum of 1,631.

The above exercise demonstrates that although the commonly accepted population of 2,000 is within the range of possibility, it is probably too low. The minimum plausible estimate is 1,631, but the most reasonable range is between the liberal and

conservative estimates of 2,522 and 3,442. Thus, Dumont d'Urville's estimate of 2,000 to 3,000 appears more accurate than Duperrey's commonly accepted estimate of 2,000. And 3,000 would probably be the best round estimate for the population of Kosrae at contact.

Depopulation and the Contact Population

When the first missionary census of Kosrae was taken in 1855, there were only 1,106 islanders. For our estimate of 3,000 people at contact to be correct, the Kosraen population must have dropped by nearly two-thirds between 1828 and 1855. By examining the course of Kosraen depopulation, we can assess the reasonableness of this estimate. Table 4 summarizes the population estimates and censuses of the island between the early contact period and the low point of population in the 1880s.

As a result of the scarcity of population estimates between the first contacts and the missionary censuses of the 1850s, it is difficult to determine exactly when the population began a rapid decline. Captain Cathcart of the ship NANTUCKET visited Kosrae in 1843 and estimated 2,000 inhabitants (Ward 1967 : 565). In the same year, a Captain Rounds investigated a Kosraen attack on a European ship. His account claimed that "resistence [sic] would appear to have been hopeless, for although the island is not more than twenty-seven miles in circumference, it is very thickly populated, and from 300 to 400 natives were frequently seen on the shore at one time" (Ward 1967 : 571). Although it is obvious that the writer was trying to emphasize the threat Kosraens presented to Europeans, his account suggests that there had not been massive depopulation prior to that time.

However, by 1848 depopulation was quite apparent. William Jackson (1849 : 10) visited Kosrae in January of that year and wrote an article for a Honolulu missionary journal:

> As near as I could learn there are about 12 or 1500 inhabitants upon both islands though I had no opportunity to ascertain correctly. They are in a deplorable condition. There is a general sickness prevailing, a species of fever. They also have a *foul* disease raging among them, together with other maladies. Some were dieing [sic] daily, and I think unless they have some relief, all the inhabitants must in a few years be swept away.

Captain Caloft of the HOBEORICOCK visited Kosrae in 1850, and his observations were also published in THE FRIEND: "He estimates the population at 1500 natives; ... The population is now decreasing through the prevalence of colds, consumption, and other diseases (THE FRIEND 8 [1850] : 68)." When the missionary Benjamin Snow took up residence on the island in 1852, he was told by the trader Kirkland that a recent European resident, Captain Hussey, had made trips around the island in 1851 and 1852 and estimated the population to be 1,400 to 1,700 (Lewis

Table 4. Population estimates of Kosrae, 1840–1880.

Year	Estimate (E) or Census (C)	Population Total	Source
1843	E	2,000	Cathcart (1844 in Ward 1967:571), ship captain, length of stay unknown.
1848	E	1,200–1,500	Jackson (1849:10), ship captain, length of stay unknown.
1850	E	2,000–3,000	Jurien de la Gravière (1854:291), ship captain, stayed one week at Leluh. The figure is probably taken from Dumont d'Urville's (1835 II:461) earlier estimate.
1850	E	1,500	Caloft (The Friend 8:68), ship captain, length of stay unknown.
1851–52	E	1,400–1,700	Kirkland and Hussey, resident traders on Kosrae. Reported by the missionary Snow (Missionary Herald 49 [1853]:86).
1853	E	1,300	Hammet (1854:65), ship captain, length of stay unknown.
June 1855	C	1,106	Snow (1855), resident missionary.
1856	C	975	Snow (Missionary Herald 53 1857:253), resident missionary.
Dec. 1857	C	830	Snow (Missionary Herald 55 1859:98), resident missionary.
Dec. 1858	C	747	Snow (Missionary Herald 56 1860:37), resident missionary.
1862	E	600	Snow (in Sarfert 1919:138), resident missionary.
1867	E	600	"Mission" (in Lewis 1949:59), probably from letters of missionary Snow.
1868	E	500	Snow (Missionary Herald 64 1868:319), fromer resident missionary.
1869	E	600	Pogue (Missionary Herald 66 1870:199), missionary visitor.
1872	E	300	Alexander (Missionary Herald 69 1873:93), missionary visitor.
1873	E	200	Wood (1875:188), yachting captain, 2-week visit.
Oct. 1874	C	397	Snow (Missionary Herald 71 1875:136), former resident missionary on return visit.
1880	E	200	Finsch (1893:452), German ethnographer, visited Kosrae for a brief period of time.
1880	E	400	Hernsheim, German trader and consul, visited Kosrae with Finsch (1884:55).

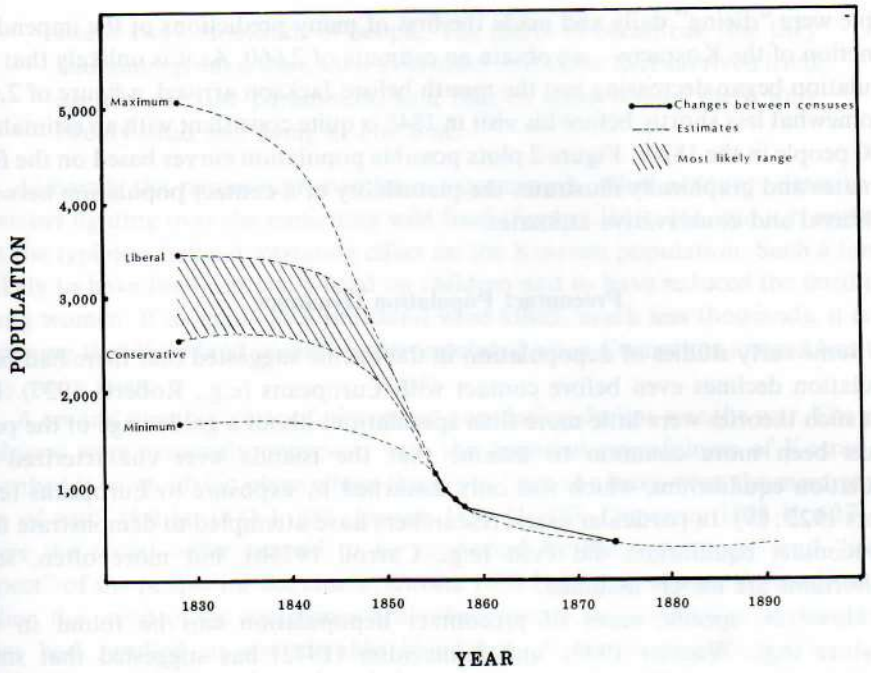

Fig. 2. Estimated population changes on Kosrae Island, 1828–1890. The sources are given in Table 4 and the text.

1967 : 6). Hussey's is the first estimate by a European who actually lived on Kosrae, and thus should be more credible than those of earlier visitors. At any rate, it is apparent that the Kosraen population had begun a rapid decline sometime before 1848.

When Snow took his first census in 1855, he found 1,106 people including 239 children but only one infant. At that time, 113 had just died from an influenza epidemic and 96 were sick. This first census clearly shows that both Lesson's and Lütke's population estimates were too low. After a number of years of depopulation, the island still contained more than the 800 adults Lütke had estimated. And including the 113 who had just died, there were more that the 1,200 total estimated by Lesson. Snow's second census in 1856 found only 975 people. In December 1857, the population was just 830; and by December 1858, it had dropped to 747 (see Table 4 for sources).

Between June 1855 and December 1858, the population decreased at an alarming rate of 11% per year. Checking this figure against the 1856 and 1857 censuses shows that the rate was fairly constant throughout the period. If we use this rate to project the population backwards, we obtain a total of 1,670 in December 1851—a figure that is consistent with Hussey's estimate of 1,400 to 1,700. If we project the 11% rate of decrease back to December 1847—the month before Jackson observed that the

people were "dieing" daily and made the first of many predictions of the impending extinction of the Kosraens—we obtain an estimate of 2,660. As it is unlikely that the population began decreasing just the month before Jackson arrived, a figure of 2,660 or somewhat less shortly before his visit in 1848 is quite consistent with an estimate of 3,000 people in the 1820s. Figure 2 plots possible population curves based on the four estimates and graphically illustrates the plausibility of a contact population between the liberal and conservative estimates.

Precontact Population Dynamics

Some early studies of depopulation in the Pacific suggested that there had been population declines even before contact with Europeans (e.g., Roberts 1927). But most such theories were little more than speculations about a golden age of the past. It has been more common to assume that the islands were characterized by population equilibrium, which was only disturbed by exposure to Europeans (e.g., Rivers 1922: 89). In particular cases, researchers have attempted to demonstrate that a precontact equilibrium did exist (e.g., Carroll 1975b); but more often, such equilibriums are merely assumed.

However, specific cases of precontact depopulation can be found in the literature (e.g., Weckler 1949), and Kunstadter (1972) has suggested that small populations are generally subject to random fluctuations rather than characterized by stability. The Kosraen population, large enough not to have been at the extreme mercy of random fluctuations, also appears to have suffered a period of precontact depopulation.

Even 3,000 is a rather low population for an island the size of Kosrae. Yap, which is nearly the same size (although with a less rugged interior), is estimated to have supported as many as 40,000 people at contact (Underwood 1973: 45). The early explorers felt that Kosrae could have supported many times the current population. As noted above, fertility appears to have been high and illnesses few. Thus, the physician Lesson concluded that the island was a healthy place and wondered what "vicious custom" kept the population so low. Sarfert (1919: 53) felt that the Kosraens were suffering from a cultural decline and loss of vigor at the time of contact, resulting in population decline. However, Lewis (1949: 68) points out that there is no reason to attribute any population drop to such "inner causes." Rather, a precontact typhoon and war are sufficient by themselves to explain a considerable population drop before the European visits.

The typhoon is doubtless the same one which depopulated Mokil (Wecker 1949) and other Caroline Islands in the late 18th century. In 1852, the typhoon was described to the missionary Gulick by the paramount, who had lived through it as a boy. Gulick (1932: 503) wrote in his journal,

> ...their houses were swept away, their breadfruit and cocoanut trees were broken down, and consequently a famine followed which

> swept away thousands of people. The stores of breadfruit that they had underground were soon exhausted and those that survived lived on fish. He [the paramount] said that in some houses there were twenty dead and dying at one time.

Although the paramount may have exaggerated, other accounts describe the survivors fighting over the remaining wild food (Sarfert 1919:26), and it is apparent that the typhoon had a devastating effect on the Kosraen population. Such a famine is likely to have been especially hard on children and to have reduced the fertility of young women. If as many as a thousand were killed, much less thousands, it is not surprising that the island seemed underpopulated when Europeans arrived less than forty years later.

A second possible cause of precontact population decline was the war. The early explorers were extremely impressed with the apparent peacefulness of Kosrae and described it as an idyllic place where there was "not the least, even the most remote idea of war" (Lütke 1833 I:385; Lesson 1839 II:477; Duperrey 1828 II:637) and where the social order seemed to be supported by the "reverence" and "innate respect" of the people for the chiefs (Kittlitz 1858 I:356). However, a decade or two earlier, the revolt of the commoner *Muhtuhnte* people and their allies on the western coast had resulted in considerable bloodshed. A tradition collected by Lewis (1949:48) in 1947 relates how the rebels were massacred and their wives burned alive with the bodies. Although that account may be exaggerated, it is likely that many adults died in the war. And it is small wonder that the commoners of the western coastal area were extremely deferential in the presence of the chiefs of Leluh. Other stories of war and capital punishment suggest that such conflict may have been recurrent.

Thus, it appears that the Kosraen population fluctuated long before the introduction of European diseases. Despite the low overall total, the fairly high proportion of children indicates that the Kosraen population may have been increasing at the time of contact, recovering from the effects of the typhoon and war rather than suffering from loss of vigor or a "vicious custom." If so, the recovery was soon cut short by the devastating effects of introduced diseases.

Summary

In the Kosraen case, enough data exist to carefully evaluate 19th century contact population estimates. Although there is no way to determine the exact population at contact, a fairly narrow range of reasonable estimates can be derived. The evidence affirms that Kosraen population history includes a period of traumatic depopulation. We know that the population dropped by two-thirds in the 19 years between Snow's first and last censuses. But our population estimate at contact suggests that depopulation was even more extreme: between contact and Snow's first census in 1855, the population may already have decreased by nearly two-thirds. And the population

at its lowest point in the 1880s would have been only about one-tenth of what it had been 60 years earlier.

The evidence also suggests that in the case of Kosrae, most—if not all—of the initial population estimates were low rather than high. If it is true that contact estimates of Pacific island populations have tended to be inflated, we must ask why the estimates of the Kosraen population were so low. Perhaps the scientists and explorers of the first two European vessels to stop at Kosrae were more conservative than many of the explorers who first landed on other Pacific islands. It is also possible that the settlement pattern and the size of an island are factors influencing population estimates. On a relatively small island like Kosrae, there may be less tendency to exaggerate population estimates than on larger islands like Tahiti. And where settlements are dispersed rather than nucleated, as on the main island of Kosrae, visitors might be given the impression of sparse settlement, leading to low population estimates. This might explain why the independent estimates for the nucleated village on Leluh island were high compared to Lütke's count while totals for the dispersed settlements of the main island tended to more closely agree with his low enumeration. The Kosraen case suggests that we cannot assume that contact population estimates were inflated rather than deflated, but must take into consideration the circumstances of the estimate and the settlement pattern of the island.

Finally, the discussion of precontact population dynamics and the fact that Kosrae clearly was much less populated than some similarly sized islands demonstrate that we cannot assume that island populations were characterized by equilibrium or a tendency toward an optimum size. If a highly stratified island such as Kosrae were subject to precontact depopulation, other medium-sized and larger islands may also have experienced population fluctuations. Consequently, although population equilibriums may indeed have existed on particular Pacific islands, they should not merely be assumed.

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