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Population Dynamics of an Atoll Community

By WILLIAM A. LESSA* AND GEORGE C. MYERS*

INTRODUCTION

The objective of this paper is to present further demographic data and analysis for the atoll community of Ulithi in Micronesia. A census conducted by the senior author in 1960 to complement a prior enumeration in 1949 affords an opportunity still relatively rare to study the dynamics of population change for a primitive community. This paper specifically attempts to reassess generalizations regarding the balance of population derived from the earlier study,[1] and provides an example of the modest type of micro-demographic analysis which can be undertaken through the joint cooperation of an anthropologist and demographer. It is our firm belief that the relatively stable cultural conditions of primitive communities present a relevant and rewarding context for the study of population by the demographer. In turn, such study serves as a source of important insights for the field anthropologist.

Ulithi Atoll consists of five inhabited islands located about 380 nautical miles south-west of Guam. Since 1944 it has been under control of the United States of America, which now administers it as part of a United Nations trusteeship. Prior to that, the atoll was under Japanese control for thirty years, and German administration for fifteen years initiated in 1899. While the islands have been under nominal outside control for over half a century, the culture of the Ulithians has remained surprisingly intact.

Social organization is based on matrilineal lineages with patrilocal residence. Political control among the islanders is exercised by village councils, district chiefs, and a king. There is virtually no social stratification. Educational instruction of rather elementary character is given by native teachers, and religious indoctrination is imparted by a Roman Catholic priest. Since 1937 nearly all the Ulithians have been converted to Catholicism, and a priest has been in frequent residence since 1949. Ninety-seven per cent of the islanders are now Catholics, but some older persons still subscribe to a religion based on nature spirits, ancestor worship, and celestial deities, intertwined with white magic and sorcery. In general, the people seem to be psychologically well adjusted and optimistic, with an overwhelming group orientation.

The economic life of the people is concentrated on fishing and cultivation of coconut, taro, squash, banana, and breadfruit. The coralline soil supports a very limited variety of plant crops, and future improvements in agricultural production are likely to be negligible. Fish and some occasional pork contribute the only items of flesh food except for imported tinned bully beef and sardines. The nutritional level of the population, however, is fairly high, although the diet is not varied by western standards. Nonetheless, the islanders are rather active

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[1] Reported in William A. Lessa, "Depopulation on Ulithi", *Human Biology*, vol. XXVII, no. 3, September 1955, pp. 161–83.

and healthy people, with some signs of increasing weight and stature appearing recently. Trade is carried on with the nearby islands of Yap, Ngulu, Fais, and Woleai. The major items of foreign export are copra, trochus shells, and simple handicrafts; the chief foreign imports are various foodstuffs, such as rice, sugar, flour, and evaporated milk, and kerosene, tools, and constructional materials.

Population Census

During the summer of 1960 a complete *de jure* enumeration of Ulithi's population was made. Information was obtained on age, sex, birthplace, religion, lineage or clan, marital experience, and fertility experience. Since this information was directly comparable to data gathered in a census dated January 1, 1949, it is possible to analyse population change rather intensively.

The senior author has spent considerable time with the people of Ulithi during his four trips to the atoll over a thirteen-year span. In addition, he has maintained some contact with local inhabitants during interim periods. This experience and contact with the people has proved very valuable in securing accurate and comprehensive census data. Careful attention, in particular, was paid to ascertaining date of birth and obtaining complete records of marital and fertility experience for each islander.[2] In the absence of a reliable registration system, census enumeration can provide this type of information so necessary for adequate demographic analysis. The relatively small size of the population, which permits extensive reliability checks and care in observation, has made it possible to compile what we feel is highly reliable demographic material.

Population Size and Distribution

The population enumerated as of July 1, 1960, consisted of 514 persons, an increase of 93 from the initial census dated January 1, 1949. The following estimates indicate that the recent increase since 1949 represents a striking departure from a long term-decline in the population of the atoll.

These figures are:

Year	Population	Source of data[3]
1731	592	Cantova (1731)
1870	ca. 700	Tetens and Kubary (1873)
1903	797	Senfft (1904)
1914	ca. 700	Finsch (1914)
1925	506	Hasebe (1928)
1930	450	U.S. Hydrographic Office (1938)
1935	443	U.S. Hydrographic Office (1945)
1946	402	U.S. Navy (1948)
1949	421	Lessa (1955)
1960	514	Lessa (Present study)

[2] For details regarding specific methods employed in conducting the 1949 Census, see Lessa, *loc. cit.*, pp. 163–64. Similar methods were employed in 1960, with modifications made possible by the fact that the old individual census forms were taken back to the islands and used to establish quickly and quite easily those persons who had died or migrated during the intercensal period. Thereafter, attention was primarily directed toward enumeration of residents who were not included in the earlier census. Interviews were not conducted by household units, since this was not feasible due to constant shifting of people from one dwelling or village to another. A list of names of all inhabitants was first compiled through key informants, then details were systematically verified by interviews with selected persons, in most cases the mother of the family. In addition to constant checking and re-checking with natives during the entire summer, missionary records were also carefully inspected as a final procedure.

[3] Complete bibliographic data concerning these sources, except for Cantova, are given in Lessa, *loc. cit.* The head count made in 1731 by Father Juan Antonio Cantova is contained in a letter he wrote

If the seemingly reliable population estimate by Senfft for 1903 is taken as a base, the annual decrement in population was −1·39 per 100 population in the forty-six year period preceding 1949. Since this latter date, however, an annual rate of growth of 1·74 per 100 persons is recorded. The major question examined in this paper concerns the possible reasons for this reversal in a secular trend of depopulation. Before this may be answered it is necessary to describe the distribution and structure of the population, and to probe factors responsible for the pattern of depopulation before 1949.

There has been a steadily increasing concentration of population on four of the islands of the atoll. Between 1904 and 1949, four islands were vacated completely and still remain unoccupied, while one island, Lossau, has steadily lost population. Figures for distribution of population are:

	Population		
Island	1904 (Senfft)	1949 (Lessa)	1960 (Lessa)
Falalop	260	126	151
Asor	101	53	59
Mogmog	95	142	175
Fassarai	79	69	118
Pigelelel	79	..	..
Sorlen	70	..	..
Lossau	59	31	11
Mangejang ..	42	..	..
Lam	12	..	..

In part, earlier changes resulted from dislocations created by the particularly disastrous typhoon of 1907. At that time, many islanders left the atoll completely, but nearly all returned later. It should be pointed out that typhoons have periodically struck the islands, resulting in minor dislocations, but no permanent emigration from the atoll.

Population Structure

The age and sex distribution of population for each island in 1960 is shown in Table 1. To appreciate the rather profound changes in population structure which have occurred during the intercensal period, an age and sex pyramid is presented which shows distribution by age and sex for both census dates.

One notes a striking increase in the size of the four youngest quinquennial age groups, particularly from ages 0–14. During the period between censuses, a numerical increase of 106 persons is reported for the population under twenty years of age. This has produced an increase of 15·7 per cent for the proportion in this total age category, contrasted with a decrease of 8·7 and 7·0 per cent for the proportion of persons aged 20–49, and 50 and over, respectively. The overall median age dropped from 39·5 years in 1949 to 27·0 in 1960. In short, there is considerable evidence that Ulithi is undergoing a significant rejuvenation of the population, essentially as a result of much larger cohorts of younger persons.

Another remarkable aspect of this population change is a shift in the masculinity ratio from 90·5 males for every 100 females in 1949, to 106·4 in 1960. Thus,

soon after he had set up a mission and baptized all the children. The letter appears in *Boletin de la Sociedad Geografica de Madrid,* vol. x, part 1, 1881, pp. 263–79. The mission was wiped out after a few months, an act that served to isolate Ulithi from Western contacts for about a century.

Table 1. *Population by age, sex, and residence,* 1960

Age	Mogmog			Asor			Falalop			Fassarai			Lossau			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
0	1	3	4	0	0	0	3	0	3	3	0	3	0	0	0	7	3	10
1	1	5	6	0	0	0	1	1	2	3	2	5	1	0	1	6	8	14
2	2	3	5	0	0	0	2	3	5	4	0	4	0	0	0	8	6	14
3	4	1	5	1	0	1	1	1	2	3	2	5	0	0	0	9	4	13
4	5	1	6	1	1	2	3	1	4	2	0	2	0	1	1	11	4	15
0–4	13	13	26	2	1	3	10	6	16	15	4	19	1	1	2	41	25	66
5–9	9	15	24	4	5	9	13	8	21	11	8	19	1	0	1	38	36	74
10–14	6	5	11	6	5	11	9	2	11	2	7	9	1	1	2	24	20	44
15–19	8	10	18	2	1	3	4	1	5	4	7	11	0	0	0	18	19	37
20–24	3	10	13	0	0	0	2	1	3	4	4	8	0	0	0	9	15	24
25–29	9	5	14	2	4	6	2	2	4	3	2	5	1	0	1	17	13	30
30–34	5	2	7	3	2	5	3	2	5	3	0	3	0	1	1	14	7	21
35–39	6	7	13	2	0	2	3	6	9	2	3	5	0	0	0	13	16	29
40–44	3	2	5	2	1	3	3	6	9	4	3	7	0	0	0	12	12	24
45–49	2	5	7	1	1	2	3	4	7	2	2	4	0	0	0	8	12	20
50–54	3	5	8	1	2	3	2	4	6	4	1	5	0	0	0	10	12	22
55–59	4	3	7	0	0	0	10	12	22	3	0	3	1	1	2	18	16	34
60–64	3	4	7	0	0	0	3	2	5	3	4	7	0	1	1	9	11	20
65–69	7	1	8	0	5	5	4	7	11	1	5	6	0	0	0	12	18	30
70–74	3	2	5	2	2	4	3	2	5	0	1	1	1	0	1	9	7	16
75–79	2	0	2	1	2	3	3	2	5	2	2	4	0	0	0	8	6	14
80–84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85–89	0	0	0	0	0	0	4	3	7	1	1	2	0	0	0	5	4	9
90–94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	86	89	175	28	31	59	81	70	151	64	54	118	6	5	11	265	249	514

there is a preponderance of males in the population at present, a rather substantial change in the sex balance for such a short period of time. This shift can be attributed in large measure to the differential sex ratios among the younger age groups. In 1960 the masculinity ratio was 164·0 for the 0–4 age span, or 41 males to 25 females, a surplus of 16 males. An explanation for this imbalance is not apparent from our study, but it most likely reflects a rather unusual turn of chance sometimes observed for small population aggregates.[4] There is definitely no indication of female infanticide, nor any significant differential in infant mortality. At any rate it has produced a dramatic change in the total population structure.

Elements of Population Change

From the previous discussion, it is clear that the most important factor accounting for the population increase is an upsurge in the number of children. But this may not be the sole factor affecting size of population. Census data for two points in time make it possible to assess the importance of natural increase and net migration on population growth. It should be noted that lack of vital statistics information prevents analysis of total fertility and mortality for those not enumerated in either census. Nevertheless, a knowledge of net change is instructive. Changes are as follows:

Population change	+93	
Population 1960 ..		514
Population 1949 ..		421
Natural increase	+78	
Births		157
Deaths..		79
Net migration	+15	
Immigration		19
Emigration		4

Although immigration accounts for some increase, population change is primarily a function of natural increase. It is possible to analyze mortality and fertility conditions more fully, in order to examine factors responsible for the population increase. Since mortality seems to be less important in contributing to these alterations, it is considered first; fertility subsequently.

Mortality

Table 2 presents a survival table for ten-year age categories of population enumerated in the census of 1949, based on the probabilities of *each cohort* surviving to the second census of 1960. The table excludes those persons enumerated in 1949 who emigrated during the period. It needs to be noted that the intercensal period extends for an eleven and a half year period, not a ten-year span as is generally true of survival tables. It was thought best not to make any adjustment to a ten-year interval.

During this period there was a strikingly high survival rate for both males and females up to age twenty. These figures do not reflect stillbirths, deaths

[4] This result is statistically significant at the 0·05 per cent level of probability.

High masculinity ratios are not uncommon for the Pacific islands. On Yap, close to Ulithi, masculinity ratios of 133, 160, 89, 109, 131, and 127 *at birth,* are reported for the years 1946–51, in Edward E. Hunt, Jr., Nathaniel R. Kidder, and David M. Schneider, "The Depopulation of Yap", *Human Biology,* vol. XXVI, no. 1, February, 1954. A high female mortality in infancy further increased the masculinity ratio for the early years of life. The authors indicate they found no evidence of female infanticide on Yap.

at birth, and probably in some cases, neo-natal deaths, but only deaths recorded for those actually enumerated in the 1949 census, less the four persons who emigrated. Yet the figures are important in clearly showing the effects of medical and health practices on mortality among the younger population.[5] The slightly lower survival rates among males for earlier age groups reflect the deaths of five males (enumerated in the 1949 census) under thirty while fishing during a typhoon in 1953. Incidentally, these are the only deaths directly attributable to the hazards of sea voyages in the period.

Table 2. *Survival table for* 1949 *cohorts by age and sex*

Age group in 1949	Males	Females	Total
0–9	0·939	1·000	0·971
10–19	0·957	1·000	0·978
20–29	0·931	0·957	0·942
30–39	0·895	0·920	0·909
40–49	0·903	0·964	0·932
50–59	0·905	0·879	0·889
60–69	0·538	0·550	0·534
70–79	0·385	0·167	0·243
80–89	0·000	0·000	0·000
90–99	0·000	0·000	0·000

Survival rates remain rather high—over 50 per cent—through the ages 60–69, then decline sharply. This indicates an extremely high longevity, a conclusion substantiated by the large number of persons over 60 in the population. In general, deaths during the intercensal period represent normal attrition. There is no indication that the steady decline in population prior to 1949, nor the subsequent population increase which followed, can be attributed to changes in the mortality experience of Ulithians.

Fertility

Fertility, it seems certain, is the factor primarily contributing to population change. In order to conceptualize the impact of fertility upon the intercensal rise in population, it is necessary to recapitulate the factors instrumental for the trend of depopulation prior to 1949. In a previous article,[6] the senior author has extensively treated these issues and we will merely summarize the major conclusions.

Typhoons already have been referred to as a factor in the decline of population following the storm of 1907. Most of the inhabitants of the atoll who were evacuated returned later to the islands. Since 1907 there have been many damaging typhoons, the most recent and severe in November, 1960; but their occurrence seems to have become accepted by the islanders as one of the normal difficulties of life in the area. The typhoons average about one and a half per year, but have never taken many lives, so the importance of this factor on mortality is not

[5] Infant mortality does not seem to be as serious a problem on Ulithi as it is on other Pacific islands. See, for example, W. D. Borrie, Raymond Firth, and James Spillius, "The Population of Tikopia, 1929 and 1952", *Population Studies*, vol. x, no. 3, March 1957, pp. 229–52.

[6] Lessa, *op. cit.*

great. Their importance for emigration also has been relatively minor since 1907, particularly because of government aid in the form of food. Therefore, there seems to be little reason to believe that typhoons in the present century have greatly contributed to population decline.

There is also little evidence that losses of men at sea could have drastically diminished the population, although it must be recognized that a number of males have perished at sea throughout the years. In view of the fact that this hazard undoubtedly existed even before the population decline, we are inclined to dismiss this factor as a major source of depopulation, especially since foreign restrictions on travel by canoe.

Certainly an important factor bearing on mortality is disease, particularly epidemics introduced into the atoll community by foreigners. Evidence exists of respiratory and poliomyelitis epidemics during the German and Japanese administrations. These were responsible for some increase in mortality, and even for some of the population decline during earlier periods. But they hardly explain the steady depopulation between 1904 and 1949. There is no malaria and few endemic infections among the Ulithians and no indication of these diseases in the past.

Of much greater importance, however, has been gonorrhœa. It appears to have been the only venereal infection prevalent among the population—syphilis being negligible or non-existent—and it definitely was introduced into the community by outsiders. The most significant aspect of this disease is that it inhibits conception, and thus serves to depress the rate of birth.[7] The prevalence of gonorrhœa was impressionistically estimated at almost 80 per cent of the adult population by a medical officer of the United States Navy in 1948. An overwhelming amount of evidence supports this view of the widespread prevalence of the disease, and we feel that it alone was mainly responsible for the population decline of the atoll in the period preceding 1949.

There are other factors which could depress a general birth rate, but they seem to have little merit for explaining population loss. Ulithians reveal no lack of desire to have children, and children have been highly valued according to the cultural standards of the community. Population control techniques, including contraceptive devices, abortion, and *coitus interruptus,* are virtually unheard of on the islands. Furthermore, there seems to be no evidence that the phenomenon is due to infrequency of sexual relations, sometimes attributed to a loss of interest in life among primitive populations.[8] The belief that the sex act weakens the individual and therefore should be avoided, which has been reported on Yap,[9] is not important on Ulithi. Finally, unstable marital patterns as revealed by rather high divorce rates and considerable extra-marital sexual relations, seem to offer no general explanation for the decline, particularly since illegitimate births constitute a sizeable portion of all births. The number of potential

[7] The effects of gonorrhœa on reproduction have been long accepted and substantiated by medical scientists.

[8] W. H. R. Rivers, " The Psychological Factor ", in W. H. R. Rivers, ed., *Essays on the Depopulation of Melanesia* (University Press, Cambridge, 1922). A more recent statement of these alleged consequences of culture contact appears in Robert F. Maher, *New Men of Papua: A Study of Culture Change* (University of Wisconsin Press, Madison, 1961).

[9] Hunt, Kidder, and Schneider, *op. cit.,* pp. 21–51.

childbearing females in the population is yet another element which may affect birth levels. A crude extrapolation of females aged 15–49 from the 1949 age and sex distribution, reveals that since 1909 the number of females was above the figure for 1949. While this approximation underestimates actual figures, it lends support to the contention that the population structure had little bearing on decreased fertility. In short, these conventional explanations for depopulation, particularly for Pacific island communities, offer no systematic answer to the depopulation of Ulithi.

The gonorrhœa theory, as it may be termed, affords the only reasonable explanation in terms of a depressed birth rate. It could certainly produce the relatively large decline in population; unlike some of the other factors mentioned, it was not a natural condition of the community before the decline; and, lastly, it offers an explanation for the rise in birth rates and population since 1949. The senior author several years ago asserted that the therapeutic programme initiated early in 1948 aimed at eliminating this venereal disease by modern drugs, particularly penicillin, would result in a dramatic decrease in sterility among females and an increase in births.[10] U.S. Coast Guard medical aides were instrumental in starting this programme, which was further promoted by the return to the islands early in 1948 of five youths who had undergone a Navy medical training programme on Palau, which consisted in part of instruction in control procedures. Consequently, this led the senior author to state that: " It now seems likely that the population of Ulithi will show a sharp upturn ".[11]

This conclusion has been borne out by the population change which has occurred since 1949. We shall now spell out the more exact nature of these changes in fertility during the intercensal period.

Both the general fertility rates and total fertility rates presented below are based on children enumerated in the 1960 census born in each particular intercensal year, and interpolation of the number of women between the ages 15–49, and by five-year age groups for each year.

It ought to be emphasized that these rates are confined to only those children who have survived to the census date. For the years 1945–48, an extrapolation of the number of females in the various age groups was made from the 1949 census age distribution. The fertility rates are as follows:

Year	General fertility rate*	Total fertility rate*
1945	31·9	1·165
1946	32·6	1·390
1947	88·9	3·395
1948	111·1	3·925
1949	141·3	5·326
1950	112·4	4·705
1951	177·8	7·210
1952	152·2	5·550
1953	164·8	6·560
1954	146·1	5·070
1955	175·8	6·450
1956	166·7	6·500
1957	142·9	4·610
1958	152·2	5·585
1959	147·4	5·115
1960 (estimated)[12]	217·4	7·650

* The general fertility rate relates the number of births in the year to the total number of women of reproductive age (15–49). The total fertility rate is the sum of the age-specific birth rates of women in the given year.

It is immediately apparent that the rates prior to 1949 are considerably lower than during the intercensal period, 1949–1960, although some increase may be noted in the rates for the earlier years. This earlier increase, we feel, primarily is due to the return of males who had been forcibly removed by the Japanese to work on military installations on Yap during most of 1944 and 1945. The figures for the years between censuses, however, are rather stable, which indicates that the pattern of fertility has more than temporary implications. The change in fertility rates following 1949 is not a reflection of variation in the number of potentially fertile females 15–49, for this number ranges between 89 and 95 for the entire period 1945–1960. Thus, the higher fertility ratios were achieved in the absence of a more favourable distribution of females in the childbearing ages. The relative similarity of the age-standardized total fertility rates with the general fertility rates, which are based only on females aged 15–49, provides further support for this contention. In short, it is clear that change in fertility occurred just prior to the 1949 census, but following the efforts to control venereal disease.

The relatively high fertility has greatly affected the average number of children for females aged 15 and over, and for fertile women, as shown in Table 3. The

Table 3. *Average children ever born alive per woman and per fertile woman, and percentage childless,* 1949 *and* 1960

Age group	Children per woman		Children per fertile woman		Percentage of women childless	
	1949	1960	1949	1960	1949	1960
15–24 ..	0·58	1·00	1·50	2·43	61·5	58·8
25–34 ..	1·65	3·40	3·45	4·53	52·2	25·0
35–44 ..	2·39	3·18	4·11	5·24	41·9	39·3
45–54 ..	1·32	2·67	2·64	4·57	50·0	41·7
55–64 ..	0·80	1·85	2·18	3·12	63·3	40·7
65–74 ..	1·09	0·84	3·00	2·33	63·6	64·0
75–84 ..	1·07	1·17	2·50	2·33	57·1	50·0
85–94 ..	0·50	0·75	1·00	3·00	50·0	75·0
Total ..	1·30	2·00	2·89	3·78	55·1	47·0

reproductive histories of these women indicate that for both categories, the mean number of children has increased between 1949 and 1960 for all but the older age groups. The percentage of childless females given in the last column also

[10] Lessa, *op. cit.* It should be noted that some sulfa drugs and penicillin had been used, for other purposes, prior to that. Moreover, Dr. Marshall Paul Wees of the U.S. Navy, who had been put ashore in December, 1944, with a pharmacist's mate to care for the natives, treated them with mapharsen, an arsenical, to clear up the widespread occurrence of yaws which he encountered. He also made some use of the newly available drug, penicillin, for the treatment of sundry infections. See his book, *King-Doctor of Ulithi* (The Macmillan Company, New York, 1950), especially pp. 23–38. In treating yaws, a disease caused by a spirochete allied to that of syphilis, he may favourably have affected the reproductive potential. The possible influence of yaws on sterility is a topic that bears further investigation.

[11] *Ibid.*, p. 180.

[12] For the first half of 1960, the ratio was 108·7. We have estimated a ratio for the entire year, although no evidence exists that the birth rate was sustained at this high level during the second half of the year.

has declined in all reproductive age groups. To summarize, these trends reveal (*a*) an increasing number of women are having children, (*b*) the women who are having children are bearing larger numbers, and (*c*) these two tendencies have contributed to an increasing average number of children for all women within the various age groups. These findings are consistent with the position held in the previous analysis.

It is also necessary to examine the trends in the marital experience and present status of the population, for this generally bears directly on fertility considerations. There are some factors which make this somewhat less important for Ulithi, but a general analysis of nuptiality is still most relevant. Traditionally Ulithians have practised monogamous marital relations, but with ample opportunity for divorce and frequent re-marriage for both the divorced and the widowed. Table 4 reveals that the average number of marriages, however, has decreased for both males and females between 1949 and 1960. For females, there are

Table 4. *Average number of marriages experienced by all males and females, and for males and females ever married, by* 10 *year age groups,* 1949 *and* 1960

Age group	Marriages per total				Marriages per ever-married			
	Males		Females		Males		Females	
	1949	1960	1949	1960	1949	1960	1949	1960
10–19 ..	0·04	0·05	0·74	0·21	1·00	1·00	1·13	1·00
20–29 ..	1·03	0·58	1·46	1·14	1·35	1·00	1·52	1·39
30–39 ..	1·21	1·30	2·00	1·52	1·35	1·46	2·00	1·52
40–49 ..	1·97	1·45	1·97	1·96	2·03	1·61	1·97	1·96
50–59 ..	2·00	2·18	2·27	2·07	2·00	2·26	2·27	2·07
60–69 ..	2·85	2·14	2·35	2·34	2·96	2·14	2·35	2·34
70–79 ..	3·31	2·65	2·50	2·15	3·31	2·81	2·61	2·15
80–89 ..	1·00	3·40	1·83	2·50	1·00	3·40	1·83	2·50
90–99 ..	1·50	..	1·00	..	1·50	..	1·00	..
Total ..	1·68	1·34	1·91	1·52	2·10	1·95	2·02	1·88

constant reductions for all age groups, except for those few persons over eighty, and no doubt past concern with marriage. The pattern of reductions for males is not consistent by age, although the total change is quite similar to that of the females. These changes reflect the efforts of the Catholic priest to implement the teachings of his church regarding marital dissolutions and the sanctity of marriage. This is further borne out by the reduction in the number of divorced persons from 40 in 1949 to 27 in 1960. Similarly, one notes in Table 5 eight persons in the population, whose marriages were annulled, which resulted from the priest's declaration that they were not legitimately married. This is an indication of the influence that these new religious norms have had on the islanders, at least with respect to marital behaviour.

Significant also is the finding that virtually all persons past thirty—females without exception—have been married at least once. Since 1949, however, the marital patterns of young adults seem to have undergone an important alteration. Both males and females are marrying at later ages according to these data:

Age groups	Males		Females	
	1949	1960	1949	1960
12–14	....	....	33·3	....
15–17	....	....	90·0	22·2
18–20	50·0	28·6	100·0	50·0
21–23	54·5	16·7	100·0	81·8
24–26	83·3	70·0	100·0	100·0

This is true particularly for females who had formerly been married at least once by the age of thirty. Females still marry at least five years sooner than males. These results further reveal the influence of the new marital norms, for marriage has become a more serious and binding thing for the young person, therefore not something to be rushed into as formerly. The Church, however, has not discouraged early marriage *per se.*

Table 5. *Marital status by age and sex,* 1960

Age group	Single		Married		Divorced		Widowed		Annulled		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
10–19	40	31	2	8	..	..	..	..	..	..	42	39
20–29	11	5	15	22	..	..	..	1	..	..	26	28
30–39	3	..	24	20	..	2	..	..	..	1	27	23
40–49	2	..	17	19	1	2	..	2	..	1	20	24
50–59	1	..	21	20	3	1	1	4	2	3	28	28
60–69	..	..	15	15	6	4	..	10	..	..	21	29
70–79	1	..	11	4	2	5	2	4	1	..	17	13
80–89	..	..	4	1	1	..	..	3	..	..	5	4
Total	58	36	109	109	13	14	3	24	3	5	186	188

These stricter rules of marriage have by no means significantly altered the pre-marital and extra-marital sexual activities of the islanders, however, but simply delayed age at marriage. One indirect, but certainly relevant, means to measure at least pre-marital sexual activity is the percentage of illegitimate births. Among the older Ulithians enumerated in both censuses, 10 per cent were born illegitimate. This rate declined slightly to 9·1 per cent for those persons born after 1949 but enumerated in 1960. There is no great stigma attached to illegitimacy in general, as there is always a demand for babies to adopt. Incidentally, many Ulithians are adopted for various other reasons, so this is considered quite normal behaviour.[13] In short, it is clear that the impact of religion has not been appreciably felt with respect to illegitimate conceptions, and by inference, to pre-marital sexual activity.[14]

[13] In 1949, 45·0 per cent of the population was adopted; in 1960, 43·2 per cent. All formal adoptions take place before the birth of the child, while the mother is still pregnant.

[14] During the time when the native culture had not yet felt the effects of missionization there were several taboos, religious and otherwise, against coition. These prohibitions could hardly be said to have accounted for depopulation, for they were not new. Moreover, many of them centred around religious specialists. To avoid restraints it was a common practice for men to wait until middle age before deciding to assume magico-religious duties. A former taboo made it mandatory for a husband to refrain from relations with his wife after she had borne a child, until such time as the child was able to walk to the shore and dunk his head in the water without assistance. This prohibition, not being new, could not have accounted for depopulation, especially since nothing prevented the man, nor his

It is important to summarize these marital conditions and how changes in these factors reflect on fertility levels. It would appear that the increasing stability of marital relationships, as indicated by the lower average number of marriages and the later ages at marriage, has been associated with increased fertility. It is noteworthy, therefore, that the average number of children per female even increased in age groups in which fewer women were getting married. In part, of course, this reflects illegitimate births, but also the fact that women are having children early in their married life. The overall pattern which emerges is that of delayed marriage, but rapid conception and births thereafter.

Future Population Prospects

At present levels of fertility, the population of Ulithi will continue to increase at an even greater pace than it has during the intercensal period. This is a necessary consequence of the larger cohorts of females coming into the child-bearing age groups. This may be delayed somewhat due to later age at marriage, but not significantly so.

Gonorrhœa has been virtually eliminated from the islands, due in large measure to the efforts of the authorities and the work of the medical aides. It is doubtful whether it will ever pose problems again. The increased awareness of drugs and health techniques also will allay any large-scale epidemics which might strike the atoll community. Improvements in infant mortality can be expected as the result of improved methods of childbearing and the work of a native male nurse, in particular, who recently has served as attendant in an increasingly large number of deliveries. Thus, the prospects indicate both improved fertility and mortality conditions, which have come about through modern health and medical practices and the training of a few islanders in the administration of drugs.

The effect of religion on marital and sexual activity is more difficult to assess. If any restriction upon pre-marital and extra-marital sexual practices were successful, the trend toward later marriages would tend to postpone childbearing. From this study it appears that no basic alteration in sexual activity has taken place up to the present.

One consequence of the sex ratio disparity deserves some comment, for it could affect future marital patterns rather drastically. Short of any catastrophes exclusively selective of males, there is bound to be a sex imbalance among young adults twenty years hence. The problems which might arise have already caused some concern among community leaders, for in the absence of available mates, wives will have to be sought elsewhere. This would result in either importation of females, or emigration of the males affected. The whole situation is confounded by the matrilineal descent patterns in which lineage land is transmitted through females, thus putting women at a disadvantage if they migrate into the atoll.

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wife, from having relations with other sex partners. The fact is that during the period of population decline women simply were often childless, so the question was not one of spacing. At the present time the old taboos are virtually non-existent, and it may well be that, while these taboos were not the cause of depopulation, their absence may play some part in the increased birth rate.

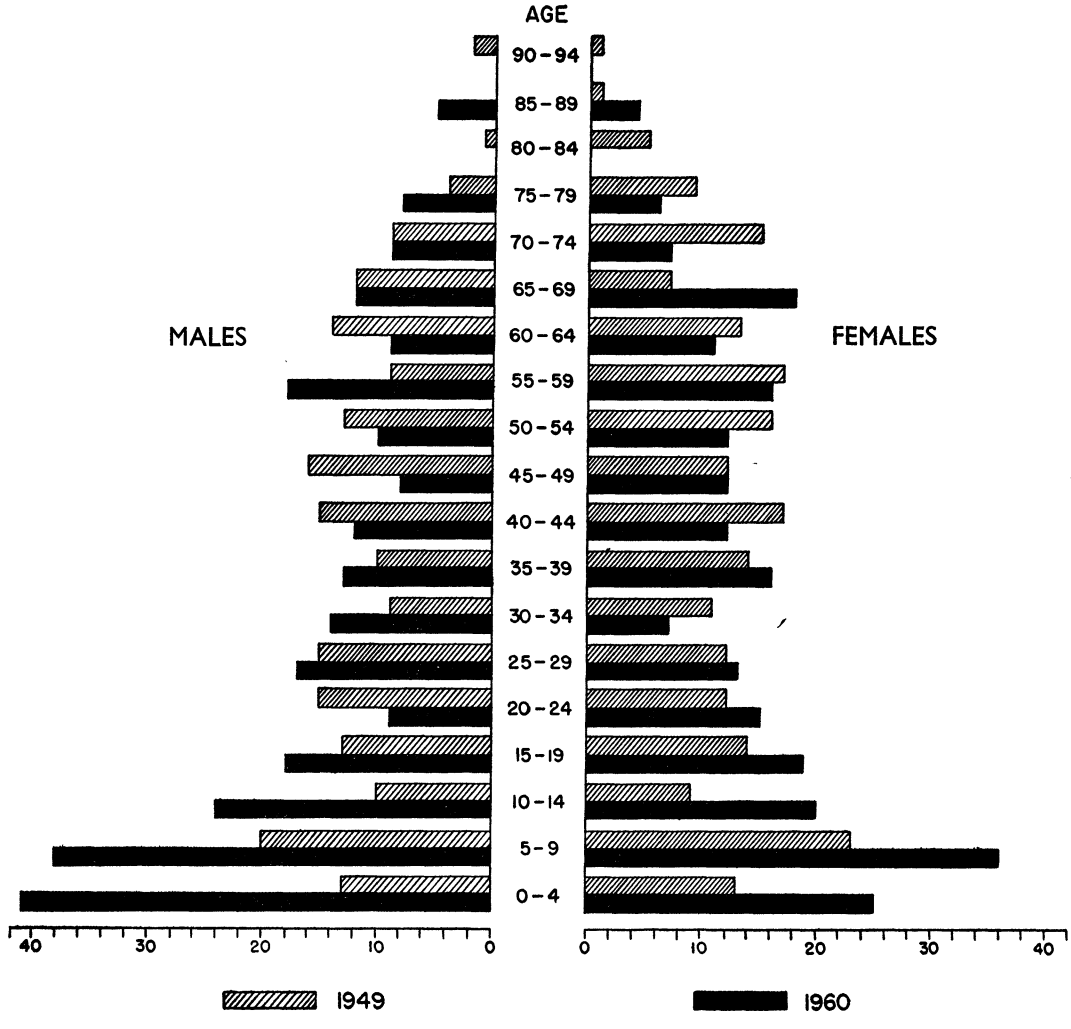
In conclusion, it is of interest to speculate on the consequences of continued population increase. The food supply is adequate but scarcely plentiful, even for the present population. Any significant increase in population certainly will put pressure on the limited means of subsistence. There remains little hope of increasing food production on these coralline islands. Importation of food requires some type of exchange commodity, which at present is largely confined to copra, trochus and unskilled labour; but there is danger to the general economy in the current drive for cash, which has affected not only the division of labour but values and work patterns as well. As far as land is concerned, it should be recalled that several islands in the atoll are uninhabited, although they have been peopled in the past during higher population levels. These islands could accommodate additional population. Then, too, many nearby islands, such as Yap, are capable of supporting numerically much greater populations. Therefore, emigration is an alternative to overpopulation on Ulithi. Of course, any conclusions regarding maximum population levels are merely speculation, but it would appear that doubling of the present population would cause serious problems in the economic and social situation of these people. From a concern with depopulation on many Pacific island communities, including Ulithi, attention may within a short period of time turn to issues of overpopulation.

Conclusions

During the period under review there appears to have taken place a dramatic shift in the gradual trend of depopulation characteristic of the atoll community of Ulithi for the first half of the twentieth century. In a previous paper, the senior author suggested that this depopulation could be reasonably attributed to the sterility-inducing effects of gonorrhœa, then prevalent on the islands. This debilitating venereal disease was introduced into the islands most likely early in this present century. Because of a programme of gonorrhœa control introduced in 1948 and continued in the years thereafter, the position was taken that fertility would increase immediately and inevitably lead to an increase in population under otherwise stable demographic conditions.

The facts that emerge from analysis of population change in the intercensal period, 1949 to 1960, clearly support this position.

The importance of these conclusions transcends this case study of Ulithi's population, for it bears on the general demographic conditions characteristic of many populations in underdeveloped countries which have a high prevalence of venereal disease, especially gonorrhœa. The impact of this disease has not been appreciated sufficiently by demographers, particularly those concerned with transition theory. The major significance of widespread gonorrhœal infection is that it affects fertility rather than mortality. Therefore, any control measures introduced result in immediate and striking increases in fertility levels, and thus usually in the level of population. We are often inclined to view the salutary effects of health measures upon mortality to the exclusion of effects upon fertility. Our evidence suggests the fallibility of such conclusions.


AGE
90-94
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50-54
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40-44
35-39
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20-24
15-19
10-14
5-9
0-4
MALES
FEMALES
40
30
20
10
0
0
10
20
30
40
1949
1960