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R. W. Hornabrook

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## The demography of the population of Karkar Island

BY R. W. HORNABROOK

*Papua New Guinea Institute of Human Biology  
Goroka, Papua New Guinea*

As a background to the I.B.P. investigation of Kaul village on Karkar Island, a study of the demography of the whole population of Karkar was undertaken. The structure of the population of Karkar is described and an account given of the patterns of movement between the various components of the island population.

The fertility of the Karkar population was quite high and significantly greater than that of families studied at Lufa in the Eastern Highlands. The reproductive age-span of Karkar women appeared to be longer than that of the Highland women at Lufa, although Karkar women married later. A significantly greater proportion of Karkar women were lactating in the 40–49 year age cohort than in the women studied in the Highlands. The mean number of living children per male was also significantly higher on Karkar than in the Highlands.

The mortality rates from Karkar are also described.

Van de Kaa (1970, 1972) has reviewed studies of the demography of Papua New Guinea's indigenous populations; his report emphasizes the paucity and inadequate nature of factual data of the total population. He has pointed out also that each small community, although in general terms New Guinean, has been subject to a unique interplay of forces and therefore displays its own demographic characteristics. A number of regional or district demographic studies have been undertaken, but in the light of the great variation in regional characteristics these provide only a limited background to New Guinean demography.

The demographic study on Karkar was conducted with a view to defining the subjects involved in the overall multidisciplinary International Biological Programme investigations, while at the same time contributing to the understanding of demographic trends in such a community.

Neither the epidemiological nor the demographic situations on Karkar can be accepted as being typical of lowland or even coastal Papua New Guinea. The island, separated from the neighbouring mainland coast by the Isumrud Strait, has been isolated from trends and developments on the mainland. Furthermore, Karkar is generally accepted as being among the most favoured locations in Melanesia. Rich soil and equitable climate have favoured economic development. The island has been influenced by expatriate commercial interests for at least half a century – in 1884 the New Guinea Kompagnie, and after 1899 the German Government, were responsible for its administration. Since then the Australian administration of the island has been disrupted by exposure to the stresses of military activity during the Second World War and a period of Japanese rule.

Coconut plantations were established before the First World War and subsequently were greatly expanded by Australian interests. Indigenous-owned small-holdings, and in some cases quite large plantations, were also established. Economic development at the village level is far ahead of that of most Papua New Guinean communities and this has culminated in the flotation of the Karkar Kompagnie, which in 1972, the first year of operations, was able to announce a substantial profit. Missions were established on Karkar soon after the appearance of government control and the population is now nominally, even staunchly, Christian. Health services

also developed at a rapid rate and in 1948 the Lutheran Mission Hospital at Gaubin was opened. Although access to certain areas of the island was limited by poor roads, in recent years a good all-weather road circumscribes the island with side roads reaching into every village.

Long-standing contact, particularly the influence of missions, health services and economic development, has influenced the present demography of the Karkar population. Censuses of the size of the Karkar population have been undertaken intermittently by the Administration. The inaccuracies involved in this demographic information have been stressed by van de Kaa (1970). The village population of Karkar, as recorded in the government census returns of the years 1925–27, was: children 3150, adults 4136, with a total population of 7286; and in 1937–39 the population was: children 4528, adults 4582 with a total population of 9110, representing an average annual increase of 1.86% which the island shares with such neighbouring off-shore islands as Manam, Bagabag and Long Island. We now report the existing structure of Karkar as defined in the course of the International Biological Programme investigation.

#### METHODS

As a prelude to the anthropometric, genetic and epidemiological studies on Karkar Island, a census of the island population was conducted. The total population of the island was recorded on printed forms devised by D. J. van de Kaa. Field-workers enumerated each dwelling on the island and recorded the inhabitants. Each individual was allotted an identification number, coded on the basis of village and sex. The marital state and offspring were recorded. The ages were noted separately depending on the source or basis on which estimations were made. The baptismal records of the Catholic Mission, the hospital records of birth and the age as noted in the census or tax registers, were noted whenever available. In those villages where medical assessments were made an estimate of each individual's age, taking into account all sources of information, was made. The forms obtained by the field-workers have subsequently been checked and re-checked and coded for computer analysis. Specific inquiries concerning reproductive functions of the female population were undertaken by Stanhope and will be reported elsewhere.

TABLE 1. RESIDENT POPULATION AGE AND SEX STRUCTURE OF KARKAR ISLAND

age-group	males	females	total	% of population	sex ratio/ males per 100 females
0-14	3 995	3 747	7 742	48.1	107
15-29	2 094	1 957	4 051	25.2	107
30-44	1 314	1 078	2 392	14.9	122
45-59	788	723	1 511	9.4	109
60+	205	176	381	2.4	117
all ages	8 396	7 681	16 077	100.0	109

#### RESULTS

##### *The population – its size and composition*

The age and sex structure of the resident population of Karkar Island are described in table 1. The age distribution of the population of Karkar reflects a marked recent expansion with a predominance of people in the younger age-groups. Only 12% of the population were

aged 45 or older; 48% were aged less than 15 years and 18.6% less than 5 years of age. The percentage age distribution given in 5-year age cohorts (figure 1) is broadly based and shows a reduction in males in the 20–24-year age cohort, which may be indicative of the absence from Karkar of young males in search of employment or education. There was no reduction in the size of the 25–29-year age cohort which might have been anticipated had a war-time reduction in fertility, accompanied by high infant mortality, as noted by Scragg (1957) in other areas involved in the war zones, occurred. The percentage age distribution drops in females from 7.4% in the cohort 25–29 years to remain steady at 4.7% in all age-groups between 30 and 44 years. There is an excess of males compared with females in all age-groups except those aged 70 and over. The birth male:female sex ratio was 1.05 in 1966–69. This ratio was derived from information supplied in response to the inquiry of the sex of the ‘last liveborn child’ and includes the liveborn children who have since died – 738 males were reported in comparison with 701 females. The deficiency in the number of females is most marked in women in the latter half of their child-bearing years, where the sex ratio is 1.22 in those aged 30–44 years.

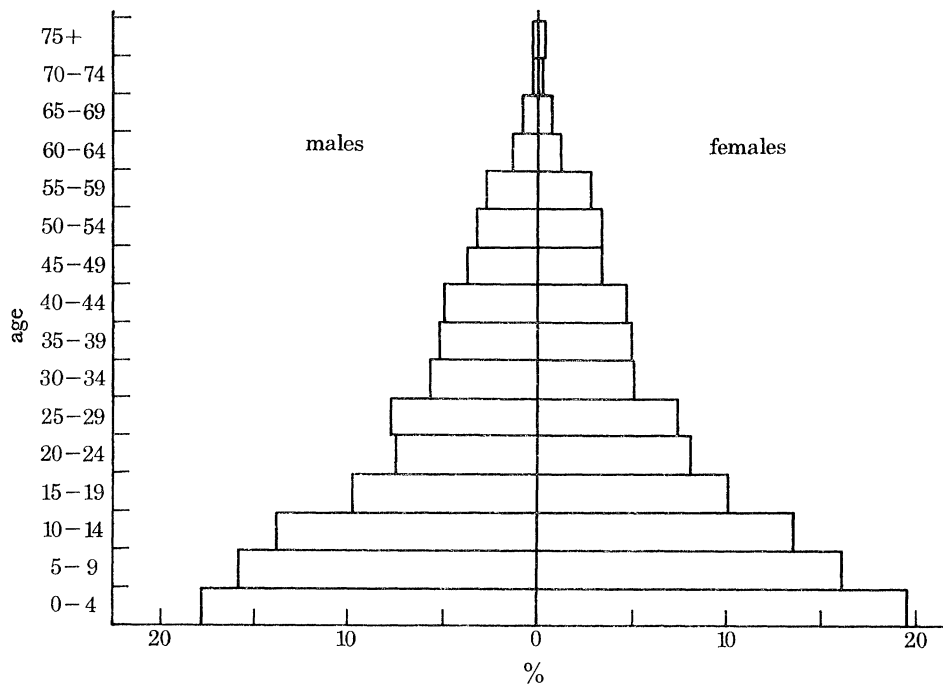


FIGURE 1. Percentage age components of Karkar Island population, January 1969.

#### MARITAL STATUS

One-third (30%) of Karkar women aged 20–24 years had never married, and in the 25–29 year cohort 11% were still unmarried. Although the majority (96%) of women were married by age 30–34, a small proportion (1.6%) of women aged 40 and over had never married in spite of a preponderance of males in all age-groups. Takia women were married at an earlier age than Waskia women.

Karkar males tended to marry later than females, with 35% of those aged 25–29 having never married, and 8% in the 35–39-year cohort still unmarried.

The proportion of widows in each age-group was less than 10% until the age 45–49, when widows contributed 11% of the female population (table 2). This proportion increased rapidly with age to 57% in women aged 60 or more years. On the other hand, the acknowledgement of widowhood as a current status was much less frequent in males, with 16% of men aged 50 years or more describing themselves as widowers. Remarrying after death of a spouse is common in New Guinea, especially in the reproductive age-groups.

TABLE 2. INCIDENCE OF WIDOWHOOD ON KARKAR

age (years)	widowhood
30–34	3.8%
35–39	4.7%
40–44	6.6%
45–49	11.1%
50–54	12.1%
55–59	33.8%
60+	56.8%

## REPRODUCTION

*Age-specific birth rates*

Measurements of the fertility for Karkar Island are summarized in table 3 on age-specific birth rate. This information is also shown in figure 2. The total fertility rate as estimated from the age-specific birth rates for women between 15 and 49 years and multiplied by 5 for 5-year intervals is 7.33. This can be compared with a figure of 3.75 in Japan in the years 1949–51.

TABLE 3. AGE-SPECIFIC BIRTH RATE

age of mother (years)	total no. of women	no. children born in 1968*	births for 1000 women
10–14	805	1	1.2
15–19	591	33	55.8
20–24	502	154	306.8
25–29	507	170	335.3
30–34	337	106	314.5
35–39	311	77	247.6
40–44	297	40	134.7
45–49	196	14	71.4
50–54	207	5	24.2
55–59	157	4	25.5

\* This table includes 14 children born during the 1969 section of the survey. However, some women interviewed in 1968 presumably had children who were born in 1968 and who were not counted. Therefore birth rates may be slightly overestimated. (Survey from 8 December 1968 to 1 March 1969.)

The crude birth rates, derived from the same data, are given by:

$$\frac{\text{no. of births in 1968}}{\text{total population}} = \frac{604}{16\,079} = 0.0376.$$

The general fertility rate is:

$$\frac{\text{no. births in 1968}}{\text{no. females between 15 and 49 years}} = \frac{604}{2741} = 0.2204.$$

If births to women over 50 years of age and to females under 14 years of age are eliminated, then this figure for general fertility rate becomes 594/2741 or 0.2167.

*The gross reproduction rate*

The sum of the age-specific birth rates of women aged 15 to 49 years and the births restricted to those of female sex only are described in table 4. The gross reproduction rate overall is 3.520.

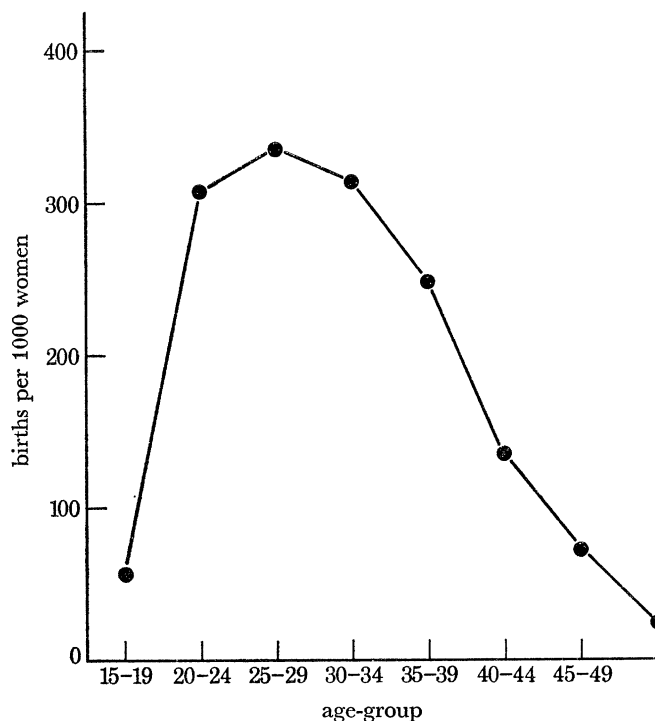


FIGURE 2. Age-specific birth rates for Karkar Island women.

TABLE 4. GROSS REPRODUCTION RATE

The sum of age-specific birth rates of women aged 15-49, restricted to female births only

age of mother (1968)	total no. of women	no. females born 1968	female births per 1000 women
15-19	591	14	23.7
20-24	502	73	145.4
25-29	507	76	149.9
30-34	337	47	139.5
35-39	311	39	125.4
40-44	297	22	74.1
45-49	196	9	45.9

Sum of age-specific rates = 703.9.

*Number of living and dead children for women who were ever married*

The mean number of living and dead children for women who were ever married by age-group is summarized in table 5, and the same information for the total female population is described in table 6. When these data were broken down and analysed on the basis of the Waskia and Takia individuals there were some differences (table 7). In the younger age-groups, i.e. 15-19 and 20-29-year cohorts the mean number of children per woman ever married was



TABLE 5. KARKAR ISLAND: MEAN NUMBER OF LIVING AND DEAD CHILDREN FOR WOMEN WHO WERE EVER MARRIED, BY AGE-GROUP

	age-group (years)						all ages (15+)
	15-19	20-29	30-39	40-49	50-59	60+	
no. women	93	785	631	485	362	113	2469
no. living children	59	1941	2930	2397	1490	415	9232
mean living children	0.63	2.47	4.64	4.94	4.12	3.67	3.74
no. women	93	767	627	508	375	115	2485
no. dead children	2	233	583	770	799	292	2679
mean dead children	0.02	0.30	0.93	1.52	2.13	2.54	1.08
total live births	61	2174	3513	3167	2289	707	11911
total deaths	2	233	583	770	799	292	2679
reduction (%)	3.28	10.72	16.60	24.31	34.91	41.30	22.49

TABLE 6. KARKAR ISLAND: MEAN NUMBER OF LIVING AND DEAD CHILDREN PER WOMAN, BY AGE-GROUP

	age-group (years)						all ages (15+)
	15-19	20-29	30-39	40-49	50-59	60+	
no. women	591	1009	648	493	364	114	3219
no. living children	63	1986	2956	2409	1490	415	9319
mean living children	0.11	1.97	4.56	4.89	4.09	3.64	2.89
no. women	591	991	644	516	377	116	3235
no. dead children	3	238	586	774	799	292	2692
mean dead children	0.01	0.24	0.91	1.50	2.12	2.52	0.83
total live births†	66	2224	3542	3183	2289	707	12011
total deaths	63	238	586	774	799	292	2692
reduction (%)	4.55	10.70	16.54	24.32	34.91	41.30	22.41

† Live births estimated from sum of living and dead children.

TABLE 7. THE TOTAL AND MEAN NUMBER OF LIVING CHILDREN FOR WOMEN WHO WERE EVER MARRIED, BY AGE-GROUP AND CENSUS DIVISION

	age-group (years)						all ages (15+)
	15-19	20-29	30-39	40-49	50-59	60+	
<b>Waskia</b>							
no. women	33	370	331	220	178	74	1206
no. living children	19	897	1597	1130	723	250	4616
mean living children	0.58	2.42	4.82	5.14	4.06	3.38	3.83
<b>Takia</b>							
no. women	60	415	300	265	184	39	1263
no. living children	40	1044	1333	1267	767	165	4616
mean living children	0.67	2.52	4.44	4.78	4.17	4.23	3.65
<b>Karkar</b>							
no. women	93	785	631	485	362	113	2469
no. living children	59	1941	2930	2397	1490	415	9232
mean living children	0.63	2.47	4.64	4.94	4.12	3.67	3.74

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slightly higher in the Takia Census Division, reflecting the earlier age of marriage in that area. In the age-groups 30–39 and 40–49 the mean number of living children per woman ever married was higher in the Waskia than in the Takia. This difference was significant ( $P < 0.01$ ) in the 30–39-year group. In all ages combined, the mean number of living children for women who were ever married is  $3.83 \pm 0.06$  in Waskia, which is significantly higher ( $0.01 < P < 0.05$ ) than the mean of  $3.65 \pm 0.06$  for Takia women.

*Dead children.* The information on infant and neonatal death rate is summarized in tables 8–10. Again there were some distinctions between the death rates of children in the Waskia and Takia Census Divisions and they are described in table 11. In younger age-groups (20–29), the mean number of dead children per woman is slightly higher in Takia, again reflecting the

TABLE 8. AGE AT DEATH OF LAST LIVE-BORN CHILD (MALE)

year of birth of child	child still alive	age at death of last live-born child (months)					total live-born children
		0–1	1–3	3–6	6–12	> 12	
1969/8	310	3	1	0	0	—	314
1967	258	3	2	1	1	3	268
1966	153	1	1	0	0	1	156
total	721	7	4	1	1	4	738

Male infant death rate =  $13/738 = 0.0176$ .

Male neonatal death rate =  $7/738 = 0.0095$ .

TABLE 9. AGE AT DEATH OF LAST LIVE-BORN CHILD (FEMALE)

year of birth of child	child still alive	age at death of last live-born child (months)					total live-born children
		0–1	1–3	3–6	6–12	> 12	
1969/8	276	5	1	1	2	—	285
1967	270	1	2	1	2	1	277
1966	137	0	0	0	1	1	139
total	683	6	3	2	5	2	701

Female infant death rate =  $16/701 = 0.0228$ .

Female neonatal death rate =  $6/701 = 0.0086$ .

TABLE 10. INFANT AND NEONATAL DEATHS BY AGE OF MOTHER — DATA FROM 'LAST LIVE-BORN CHILD' BORN DURING 1966–69

age of mother in Jan. 1969	child still alive	age of child at death (months)			total live-born children	neonatal death rate	infant death rate
		0–1	0–12	> 12			
10–14	2	0	0	0	2	0.0	—
15–19	46	1	2	0	48	0.0208	0.0417
20–24	285	0	1	3	289	0.0000	0.0035
25–29	388	4	8	1	397	0.0101	0.0202
30–34	254	3	7	0	261	0.0115	0.0268
35–39	213	4	7	0	220	0.0182	0.0318
40–44	139	2	4	2	145	0.0138	0.0276
45–49	54	0	0	1	55	—	—
50–54	18	0	0	0	18	—	—
55–59	5	0	0	0	5	—	—
60–64	0	0	1	0	1	—	—
all ages	1404	14	30	7	1241	0.0113	0.0242



earlier age of marriage in Takia women. In all age-groups over 29 years, the mean number of dead children per woman is higher in Waskia than in Takia, and for all ages combined this difference is highly significant, with  $P < 0.01$ .

*Percentage of live-born children dying.* The proportion of live-born children dying is significantly higher in the Waskia Census Division than in Takia, for those aged 50 years and older, and also with all maternal age-groups combined (table 12).

TABLE 11. THE TOTAL AND MEAN NUMBER OF DEAD CHILDREN FOR WOMEN WHO WERE EVER MARRIED, BY AGE-GROUP AND CENSUS DIVISION

	age-group (years)						all ages
	15-19	20-29	30-39	40-49	50-59	60+	
<b>Waskia</b>							
no. women	33	365	333	237	191	76	1235
no. dead children	1	90	346	391	434	196	1458
mean dead children	0.03	0.25	1.04	1.65	2.27	2.58	1.18
<b>Takia</b>							
no. women	60	402	294	271	184	39	1250
no. dead children	1	143	237	379	365	96	1221
mean dead children	0.02	0.36	0.81	1.40	1.98	2.46	0.98
<b>Karkar</b>							
no. women	93	767	627	508	375	115	2485
no. dead children	2	233	583	770	799	292	2679
mean dead children	0.02	0.30	0.93	1.52	2.13	2.54	1.08

TABLE 12. PROPORTION OF LIVE-BORN CHILDREN DYING IN WASKIA AND TAKIA CENSUS DIVISIONS

children	women 50+			all ages		
	alive	dead	total	alive	dead	total
Waskia	973	630	1 603	4 616	1 458	6 074
Takia	932	461	1 393	4 616	1 221	5 837
total	1 905	1 091	2 996	9 232	2 679	11 911
	$\chi^2 = 12.40, P < 0.01.$			$\chi^2 = 16.26, P < 0.01.$		

TABLE 13. KARKAR ISLAND: MEAN NUMBER OF LIVING CHILDREN PER MALE, FOR MEN WITH AT LEAST ONE LIVING CHILD, BY AGE-GROUP

	age-group (years)					total
	15-19	20-29	30-39	40-49	50+	
no. men	0	33	92	57	62	244
living children						
total	0	85	375	346	266	1072
mean	0	2.58	4.08	6.07	4.29	4.39
std. deviation	—	1.346	1.730	2.128	2.107	2.161
std. error	—	0.238	0.180	0.282	0.268	0.138

Polygamy: 232 males have one living wife; 6 males have two living wives; 2.5% of Karkar Island married men have more than one living wife.

## POLYGAMY

Polygamy on Karkar was uncommon. Only 6 of 238 males had more than one living wife. The men on Karkar in fact had more living children per male than those at Lufa (see tables 13 and 15).

## KARKAR AND LUFU: A COMPARISON OF FERTILITY AND MORTALITY DATA

Although a demographic study of the type undertaken on Karkar has not been attempted in the Highlands area around Lufa, data concerning pregnancies and their outcome with the number of deceased children was obtained in the course of the medical survey. There are some interesting contrasts between the factors influencing population growth in the two locations, set out in table 14.

TABLE 14. MEAN NUMBER OF PREGNANCIES AND MEAN NUMBER OF OFFSPRING DYING IN CHILDHOOD FOR WOMEN WITH REPRODUCTION COMPLETE OR NEARLY COMPLETE†

	Karkar Island	Lufa
no. women‡	142	194
total pregnancies	933	881
mean pregnancies	6.57	4.54
std. deviation	2.844	1.899
std. error	0.240	0.136
no. women§	134	187
total childhood deaths	258	254
mean childhood deaths	1.92	1.36
std. deviation	1.483	1.121
std. error	0.128	0.082

† Women aged 40 years or older.

‡ Figures include 8 Karkar women and 7 Lufa women aged over 40 years who have never been pregnant.

§ Women with at least one pregnancy.

The mean number of pregnancies for women reporting at least one pregnancy is significantly higher in the Karkar Island population than in the Lufa group, for all age-groups above and including the 20–29-year cohort. The mean number of pregnancies for all women interviewed is significantly higher for Karkar than for Lufa women for all age-groups above and including the 30–39-year cohort.

The observed fertility difference is not attributable to earlier maturity in Karkar Island women; although 30% of Lufa females aged 15–19 years were premenstrual compared with 19% on Karkar, the difference was not statistically significant.

The reproductive age-span of Karkar women appears to be longer than that of Lufa women; 77% of Karkar women in the 40–49 year age-group were still menstrual compared with 47% in Lufa (significantly different with  $P < 0.01$ ). The biological implications of these differences have apparently been realized, with a significantly greater ( $P < 0.01$ ) proportion of the 40–49 year cohort still lactating in the Karkar Island group (37%) compared with Lufa (14%).

The mean number of offspring dying in childhood for women aged 40 or over was significantly higher on Karkar Island ( $1.92 \pm 0.13$  offspring dying) than in Lufa ( $1.36 \pm 0.08$ ).

The mean number of living children per male was significantly higher in the Karkar population in all age-groups above and including the 20–29-year cohort, in spite of 12% of all married men in Lufa having more than one wife compared with 2.5% on Karkar (see tables 13, 15).

TABLE 15. LUFU: MEAN NUMBER OF LIVING CHILDREN PER MALE, FOR MEN WITH AT LEAST ONE LIVING CHILD, BY AGE-GROUP

	age-group (years)					total
	15–19	20–29	30–39	40–49	50+	
no. men	1	63	115	106	86	371
living children						
total	1	105	356	360	305	1127
mean	1.00	1.67	3.10	3.40	3.55	3.04
std. deviation	0.000	0.950	1.468	1.631	1.523	1.592
std. error	0.000	0.120	0.137	0.158	0.164	0.082

Polygamy: 363 males have one living wife; 41 males have two living wives; 9 males have three living wives; 12.11% of Lufa males (married) have more than one living wife.

#### DISCUSSION

The demographic studies on Karkar indicate a rapidly expanding population which has already revealed changes which are consistent with the introduction of improved economy and the development of better health and educational services. The position on Karkar is evidently distinct from that at Lufa and probably is not typical of the lowland regions of mainland New Guinea, although it could be anticipated that a similar change will appear here in the future. The impact of the Second World War does not seem to have altered any significant demographic characteristic of the population. When compared with other regions the crude birth rate on Karkar is high as is the general fertility rate. These comparisons can be best summarized in table 3. In fact the changes are more striking. If the excess of males in the Karkar population is taken into regard the actual Karkar fertility is higher than that compiled by the crude birth-rate. Attention has been drawn to the comparison of the total fertility rate on Karkar of 7.33 with that of Japan in 1949–51 of 3.75. The annual rate of growth of the population on Karkar Island, taking into account the census statistics for the years 1925–27 and 1937–39 with that in 1968 confirms this rapid increase in total population. Crude estimates of annual growth rates indicate an annual growth rate of 1.86% in the period between the 1926 and 1938 census of 12 years and a rate of 1.89% in the years from 1938 to 1968. Comparing this annual growth rate with other populations it is interesting to see that the annual growth rate in Venezuela from 1941–50 was 2.95%; in the Philippines in the years 1939–48 1.89% and in Ireland from 1951–56 0.45%. It would appear that a significant elimination of endemic malaria on the island would be associated with a marked additional surge in population growth.

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