
PREDICTIVE MODEL OF THE EXPANSION
OF CEMETERIES ON MĀJRO ATOLL
UNTIL THE YEAR 2010

Report prepared for the Historic Preservation Office, Mājro,
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MĀJRO FEBRUARY 1990

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Introduction

An increasing population requires an increasing amount of land area for habitation and for the disposal of the dead. Thus hitherto open land becomes increasingly converted to urban or suburban land. Such processes need to be kept in mind for any sensible management of the cultural and archaeological resources of a given area. This issue is of cardinal importance for the Cultural Resource Management on small atolls, where due to the limited land area available not only the modern habitation expansion occurs within strong spatial confines, but where also the pre- and early historic resources themselves have been spatially confined. The choice of the *prime* settlement locations is basically governed by environmental considerations (such as wind, wave action, protection from storms etc.), which have changed only little — if at all — since the beginning of human habitation in the Marshall islands some 2500 years ago. Thus past and present settlement locations overlap. Increasing population will i) gradually infringe onto those areas as yet unsettled and ii) intensify in those areas already settled. In both cases increased destruction of the archaeological and historical resources can be foreseen.

The present short report attempts to provide some projections to understand the extent of the land area of Mājro Atoll required for the future interment of human bodies. The current projections shall only be carried out until for the next two decades, that is until the year 2010. The projections on the extent of future requirements on habitation area shall presented in a separate report.

Population

It has become a well recognised factor that the population of Mājro has risen substantially over the past 40 years: while the total population of Mājro was as little as 1,237 persons in 1945, the population rose to 3,415 people in 1958, 5,250 people in 1967, 9,536 people on 1973, 11,893 people in 1980 and even 19,664 people in 1988. Apart from a simple population increase due to biological population dynamics such as an ever larger base population, increased fertility, reduced infant mortality and extended life expectancy, inward migration to Mājro has been a contributive factor.

The *census of population and housing 1988* (OPS 1989) contains projections for the development of the Marshall Islands population. The following approximation is based on the figures supplied for the total population as well as for the crude death rate.

Since the projections were initially run for the total of the Marshalls population, some adjustment was needed to cater for the needs of the present analysis. It is therefore assumed that the proportion of the population of Mājro Atoll in relation to the population of the Marshall Islands as a whole will remain stable at the 1988 rate of 1 : 2.17 or 46.06% of the total population.

This assumption, however, does not hold true because of inward migration to Mājro from the outer islands. Although apparently fairly limited compared to the overall biological population increase, the scale of this inward migration, which can be seen from the Census (OPS 1989: 222 Table 61), cannot be overlooked. Therefore, any assumption of a stable proportion will produce a conservative estimate which is in the interest of this study so as to avoid excessive statements which cannot be upheld.

Number of dead

Based on the present mortality and fertility rates, as well as on assumptions regarding the present and future general health standard of the Marshallese people, the demographic analysis of the 1988 census advanced a number of crude death rates. Under the assumption that the health standard and thus the life expectancy of the Marshallese population would improve, the crude death rate was considered to be falling over time. This crude annual death rate was taken as the basis for the calculation of the predicted number of dead per year. The results of this calculation are set out in table 1.

Table 1: Projections of population of the Marshall Islands, of Mājro Atoll, and of the number of deaths per year and as a cumulative total from the year 1989 to the year 2010.

Year	Projected population		Crude death rate	Yearly deaths	Cumulative total deaths
	RMI	Mājro			
1989	44407	20453	9.4	192	192
1990	46188	21274	9.4	199	392
1991	48041	22127	8.9	196	589
1992	49969	23015	8.9	204	794
1993	51977	23940	8.9	213	1007
1994	54069	24904	8.9	221	1228
1995	56216	25893	8.9	230	1459
1996	58499	26944	7.9	212	1672
1997	60851	28027	7.9	221	1893
1998	63301	29156	7.9	230	2123
1999	65844	30327	7.9	239	2363
2000	68415	31511	7.9	248	2612
2001	71341	32859	6.9	226	2839
2002	74267	34207	6.9	236	3075
2003	77193	35555	6.9	245	3320
2004	80119	36902	6.9	254	3575
2005	83829	38611	6.0	231	3806
2006	87516	40309	6.0	241	4048
2007	91203	42008	6.0	252	4300
2008	94890	43706	6.0	262	4562
2009	98577	45404	6.0	272	4835
2010	102837	47366	6.0	284	5119

Burials

In the pre-European, and early European contact period, that is the time before Christian spiritual concepts gained a foothold in the Marshall islands, burial of the common people was usually at sea, while burial of the chiefs occurred on land. Following Christianisation, however, everybody has been afforded a burial on land, thus occupying ground space. As long as the overall population density, and thus the number of dead bodies to be disposed of, was low, the impact of this was not felt.

Burial occurred at a number of small communal or, preferentially, congregational cemeteries of less than ~40 graves each. Only in the post World War II phase some larger and more concentrated cemeteries occurred, such as on Laura (Mājro), Jarōj and Wūlka. A survey of the ocean side from Jarōj to Teļap has shown that many of these cemeteries are very close to the coastline and are eroding at a rapid rate (Spennemann 1990). Even if the erosion can be stopped by expedient methods such as the installation of gavions, the practice of burying people that close to the shore needs to be reviewed and, if possible, abandoned.

In the meantime, however, a new trend has developed, where the bodies of relatives are buried on the individual wātos, rather than in existent cemeteries, and where the graves are erected close by existent housing.

For the approximation of the ground space required three hypotheses were calculated. The low hypothesis, where each individual grave pit, measuring 1.0 x 2.0m, is surrounded by 0.3m of free space, thus providing a total spacing of 0.6m between each grave. A medium hypothesis, where each grave is surrounded by 0.5m, resulting in a spacing of 1.0m, and a high hypothesis, where each grave is surrounded by 0.7, resulting in a spacing of 1.4 m. These three models take care of the various lay-outs of cemeteries observed on Mājro. While some of the clustered cemeteries, such as the one between Stacey's restaurant and the MJCC facility have a fairly close spacing of about 1m between the graves, some of the small cemeteries seen at the ocean side of Jarōj, Wūlka and Teļap have a spacing of 1.5m. These models do not take into consideration the recently developed custom to bury the dead directly next to the houses, where an even greater spacing of the graves has been observed. There is, at present, only little evidence for the actual occurrence of the low hypothesis (0.6 m spacing); this hypothesis, however, has been included to allow for a tighter "packing" of burials if centralised cemeteries be enforced.

No allowance is made in any of these hypothesis for the special burial of infants and juveniles, commonly requiring smaller grave pits; in the model, these grave pits have been assumed to be of standard adult size.

Area of burials required

Based on the above mentioned parameters a calculation of the total required area was conducted. A detailed, year by year approximation is presented in table 2. In brief, the three hypotheses advanced, low, medium and high,

showed that between ~11,000 and 21,000m² will be taken up by the year 2000, and between 21,000 and 42,000m² by the year 2010.

As outlined above, the medium hypothesis is preferred for decision making. Following this hypothesis, we can expect that 8,755m² will be required by the year 1995, 15,674m² by the year 2000, 22,840m² by the year 2005 and 30,717m² by the year 2010.

The area required for burial purposes by the year 2000 is equivalent of the size of Enarau Islet in Mājro lagoon or 5.4 % of entire Wūlka. The area required by the year 2010 is equivalent of Garra Islet, or 10.5% of Wūlka. To put these figures into perspective: it appears that, using a high estimate of population density such as the figure for Jarōj, as the base, the area required for burial purposes by the year 2000 (2010) is equivalent of the habitation area for 275 (539) people.

Table 2: Projections of the cumulative number of graves required from the year 1989 to the year 2010 and the total area covered by these graves.

Year	Cumulative total deaths	Area covered (m ²)		
		high	medium	low
1989	192	1568	1153	799
1990	392	3200	2353	1631
1991	589	4807	3535	2450
1992	794	6479	4764	3303
1993	1007	8217	6042	4189
1994	1228	10026	7372	5111
1995	1459	11906	8755	6070
1996	1672	13643	10032	6955
1997	1893	15450	11360	7876
1998	2123	17330	12742	8835
1999	2363	19285	14180	9831
2000	2612	21316	15674	10867
2001	2839	23166	17034	11810
2002	3075	25092	18450	12792
2003	3320	27094	19922	13813
2004	3575	29172	21450	14872
2005	3806	31062	22840	15836
2006	4048	33036	24291	16842
2007	4300	35093	25803	17890
2008	4562	37233	27377	18981
2009	4835	39456	29011	20114
2010	5119	41775	30717	21297

However, the distribution of population Mājro Atoll is far from even, with a population cluster on the three islands of Jarōj, Wūlka and Teļap (OPS 1989 and table 3). Of a total of 19,664 people living at present on Mājro Atoll, 14,646

(or 75.5%) live on those three islands. The present overcrowding of these three islands implicates that the habitation area on these islands permits only a very limited expansion and/or concentration.¹ It can be expected that the habitation area will expand further along Rairok and even Ajeltake.

Despite this overall trend of settlement expansion, however, it can be predicted that there will continue to be a tendency to bury the dead on Jarōj, Wūlka and Teļap, either in communal or congregational cemeteries, or within the individual house allotments. This is borne out of the perceived emotional need or desire to bury the dead within one's own home range. In addition, it appears, the graves have attained a new function, that of a symbol of power and status: in several unrelated incidences a bitter wrangle has occurred among relatives on whose wāto the dead be buried. It is understood by the author that the morgue at the Hospital at Teļap is often filled with dead whose relatives are fighting over the place of interment.

Despite these tendencies, however, it can be foreseen that burial on Jarōj and Wūlka will become increasingly difficult, especially if burial very close to the shoreline will become banned and if burial in the individual wātos, close to the habitation area will be outlawed because of potential heath hazards and contamination of the groundwater lens.

Table 3: Distribution of population on Mājro Atoll in 1988 (data after OPS 1989)

District	Population	Area (km ²)	Pop. density
Jelter	24	0.233	102.96
Rongrong	245	0.355	690.47
Calalen	19	0.259	73.36
Biken	8	0.052	154.44
Enemonet	6	0.130	46.33
Denmeo	7	0.052	135.14
Bokrej	14	0.041	337.84
Drirej	16	0.130	123.55
Garra	9	0.034	267.30
Ejit	170	0.049	3,454.58
Enarau	3	0.016	193.05
Djarrit	6813	0.389	17,536.68
Uliga	2144	0.293	7,325.66
Dalap	5692	0.648	8,790.73
Rairok	2021	0.622	3,251.29
Ajeltake	556	5.180	477.41
Woja	224		
Arrak	118		
Laura	1575		

¹ The concentration of housing can be seen from the unproportional rise of population on those three islands and also by the (atollwide) increase in persons per household. In 1980 the average household had 7.8 persons, while in 1988 this figure was 8.83.

A look ahead

Following on from this, we can foresee that cemetery regulations of some sort are likely to be introduced in the near future, possibly leading to the creation of one or more compulsory communal and/or congregational cemeteries either on the islands joined together by causeways (from Jarōj to Laura), or on one of the larger of the small islands on the windward side of the atoll, such as Calalin, currently (1988) inhabited by only 19 people.

Unless radically alternative methods of disposal, such as compulsory cremation or burial at sea are contemplated, the Historic Preservation Office has an interest in monitoring where new cemeteries will be erected, as it can be anticipated that some sites may be impaired or even destroyed. It is therefore suggested that the HPO remain in close co-operation with the Ministry of Interior and Outer Island Affairs and the Mājro Atoll Local Government.

A more imminent aspect of the increased number of dead to be catered for is the utilisation of habitation compounds on Laura. In the 1988 census (OPS 1989 and table 3) the population of Laura accounted for 8% of the total population. If this proportion remains stable, then we can expect that by the year 2000 some 1,250m² will be required as cemetery area and 2,460m² by the year 2010. Given the trend to bury close to existing habitation one can foresee that burial will take place within or immediately adjacent to the present, and also past, centre of habitation, thus impairing the existing archaeological sites even further. In view of the importance of the Laura sites it would be recommendable if the Ministry of Interior and Outer Island Affairs in conjunction with the Mājro Atoll Local Government could look into the matter, possibly contemplating the creation of one or more compulsory communal and/or congregational cemeteries in Laura, along the lines of the now defunct Post-World War II cemetery at the north end of Laura. Any newly formed cemetery, however, should be designated well away from the present shoreline.

Conclusions

A predictive investigation was carried out to approximate the number of dead to be expected on Mājro Atoll until the year 2010. An analysis of the space taken up by these burials was also carried out. Three hypotheses, low, medium and high, were advanced, showing that between 11,000 and 21,000m² will be taken up by the year 2000, and between 21,000 and 42,000m² by the year 2010.

The figures advanced above are, of course only very crude approximations based on a fair number of assumptions and the accuracy of the predictions should be treated accordingly. Nevertheless, the figures document the scale of the problem to be anticipated.

The present overcrowding of Jarōj and Uliga, and to lesser extent, of Teļap, implies that cemetery areas will have to be opened in other areas, thus possibly impairing the well-being of archaeological sites. It is seen imperative that the Historic Preservation Office be closely involved in any discussion relating to future cemetery policies.

References

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