MICRONESIAN

JOURNAL OF THE HUMANITIES AND SOCIAL SCIENCES

Vol. 4, nº 1 Dry Season Issue June 2005

TRADITIONAL AND NINETEENTH CENTURY COMMUNICATION PATTERNS IN THE MARSHALL ISLANDS

Dirk HR Spennemann
Institute of Land, Water and Society, Charles Sturt University

In the atoll world of Micronesia, any traditional communication between the populations within an atoll and especially between atolls relied on sea voyages by canoe. This paper considers the situation in the Marshall Islands, a group of atolls arranged in two parallel chains. The paper sets out the (re-)construction of communications networks based on graph theory and then provides a discussion of the evidence on communications in the early Marshall Islands. This draws together data as diverse as traditional stick charts, known voyages and their durations, as well as linguistics, epidemiology and biogeography. Based on a combination of these data a network model is proposed.

Micronesians have a long and well-deserved reputation for long-distance open sea voyaging in canoes that are deemed small by European standards. Navigation occurred by stars and by an understanding of wave patterns caused by the reflection and refraction of the ocean swell by the various atolls and islands. Unlike in terrestrial environments, any communication between the populations within an atoll and especially between atolls had to rely on sea voyages by canoe. Given the in-depth knowledge of navigation Micronesians possessed, one can theorize that communication could have occurred between any two given islands without the involvement of intermediary islands or stepping stones. While the theoretical connectivity is only limited by the overall number of islands, connectivity in the real world is influenced and governed by technological aspects, such as the reliance of the canoes on the presence of wind, and the social aspects, such as inter-atoll alliances and dependencies.

This study will examine the communication patterns in the Marshall Islands during the eighteenth and nineteenth centuries. It does *not* consider the nature and direction of initial colonisation. While ethnographic sources, as well as the observations made by early visitors contain some scattered information on traditional communications patterns in the Marshall Islands, to date no systematic assessment has been attempted.

This paper will first carry out the modelling of a communications network between the atolls of the Marshall Islands based on graph theory. These models will then be compared with the collated available evidence, derived from historical and archival sources as well as from linguistic, epidemiological and biogeographical data.

THE SETTING

The Marshall Islands, comprising 29 atolls and 5 islands, are located in the north-west equatorial Pacific, about 3790km west of Honolulu,

This is a peer reviewed contribution. *Received*: 30 Jun 2005; *Revised*: 8 Sep 2005 *Accepted:* 9 Sep 2005
 ISSN 1449-7336
Letao Publishing, PO Box 3080, Albury NSW, Australia

about 2700km north of Fiji and 1500km east of Ponape. With the exception of the two north-western atolls, Enewetak and Ujelang, the Marshall Islands are arranged in two island chains running roughly NNW to SSE: the western Ralik Chain and the eastern Ratak Chain (figure 1). The atolls can be as small as Taka Atoll with only 0.6 km^2 combined land area or as large as Kwajalein Atoll, the world's largest atoll with a lagoon area of 2,174 km^2 but only 16.4 km^2 combined landmass (Table 1).

Table 1. Geographical characteristics of the atolls of the Marshall Islands.

	Location (Lat. & Long		No. of	Land area (km^2)		Lagoon area (km^2)		Ratio land to lagoon area	
Atoll	North	East	Islets	area	rank	area	rank	ratio	rank
Ailinginae	11°10'	166°20'	25	2.80	19	105.96	19	2.64	11
Ailinglaplap	7°26'	169°00'	52	14.69	3	750.29	6	1.96	16
Ailuk	10°20'	169°52'	35	5.36	16	177.34	17	3.02	10
Arno	7°10	171°40'	83	12.95	4	338.69	12	3.82	8
Aur	8°12'	171°06'	42	5.62	15	239.78	14	2.34	14
Bikar	12°15	170°6	6	0.49	30	37.40	26	1.32	19
Bikini	11°30'	165°25'	36	6.01	12	594.14	9	1.01	23
Bokak	14°32'	169°00'	11	3.24	18	78.04	23	4.15	7
Ebon	4°38'	168°40'	22	5.75	14	103.83	20	5.54	4
Enewetak	11°30'	162°20'	40	5.85	13	1,004.89	3	0.58	29
Erikup	9°08'	170°00'	14	1.53	25	230.30	15	0.66	27
Jabwat	7°44'	168°59'	1	0.57	29	—	32	100.00	32
Jaluit	6°00'	169°34'	84	11.34	5	689.74	7	1.64	17
Jamo	10°7'	169°33'	1	0.16	31	—	33	100.00	33
Kili	5°37'	169°7'	1	0.93	28	—	31	100.00	31
Kwajalein	9°00'	166°05'	93	16.39	1	2,173.78	1	0.75	26
Lae	8°56'	166°30'	17	1.45	26	17.66	27	8.21	3
Lib	8°21'	167°40'	1	0.93	28	—	31	100.00	31
Likiep	9°54'	169°10'	64	10.26	6	424.01	10	2.42	13
Majuro	7°3'	171°30'	64	9.17	8	295.05	13	3.11	9
Maloelap	8°40'	171°00'	71	9.82	7	972.72	4	1.01	22
Mejit	10°17'	170°52'	1	1.86	22	—	30	100.00	30
Milli	6°05'	171°55'	84	14.94	2	759.85	5	1.97	15
Nadikdik	6°20'	172°10'	18	0.98	27	3.42	29	28.79	2
Namo	7°55'	168°30'	51	6.27	11	397.64	11	1.58	18
Namorik	5°37'	168°7'	2	2.77	20	8.42	28	32.92	1
Rongelap	11°19'	166°50'	61	7.95	10	1,004.32	2	0.79	25
Rongerik	11°20'	167°27'	17	1.68	24	143.95	18	1.17	21
Taka	11°18'	169°35'	5	0.57	29	93.14	22	0.61	28
Ujae	9°00'	165°45'	14	1.86	22	185.94	16	1.00	24
Ujelang	9°50'	160°55'	32	1.74	23	65.97	24	2.63	12
Utirik	11°12'	169°47'	6	2.43	21	57.73	25	4.22	6
Wotho	10°05'	165°50'	13	4.33	17	94.92	21	4.56	5
Wotje	9°26'	170°00'	72	8.18	9	624.34	8	1.31	20

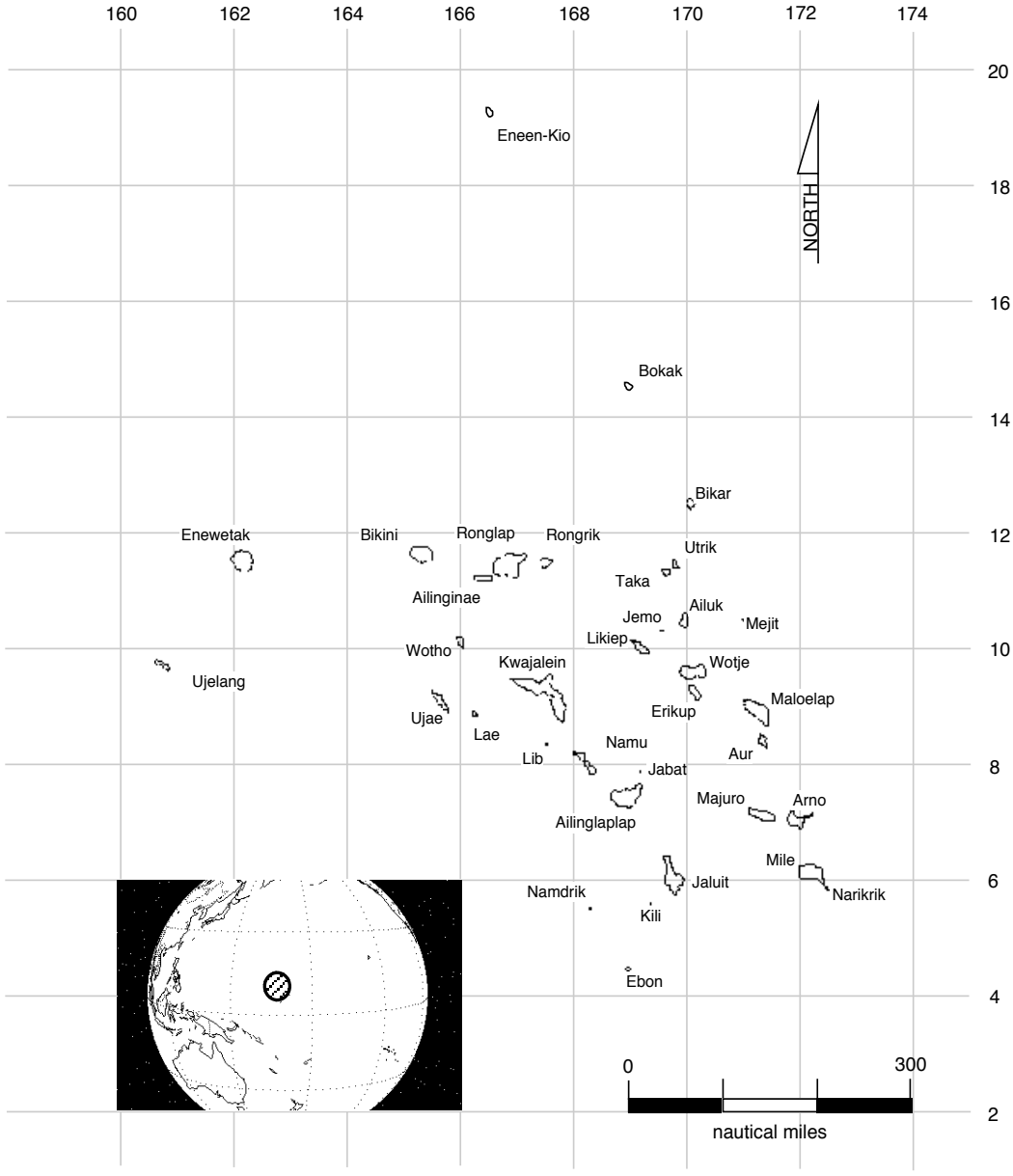

Figure 1. Index map of the Marshall Islands showing the atolls mentioned in the text.

GRAPH THEORY

Network analysis has frequently been utilised in the reconstruction of relationships between prehistoric populations as inferred from archaeological sites (*cf* Irwin 1985; Hunt 1988; Spennemann 2003). Various propositions have been made, ranging from empirically well-founded gravity models to refined models influenced by social and societal parameters, such as the inclusion of dependent daughter settlements which are tied politically to one entity. Following Hunt (1988), it is assumed that 'where interaction and movement of people take place over geographic distances, … people tend, in general, to interact more with close neighbours, than with those located further away.'

It needs to be stressed that any graph theoretical analysis assumes that the entity of sites is absolute, that is that all sites belonging to the network are known. In the case of the atolls of the Marshalls, this can easily be demonstrated.

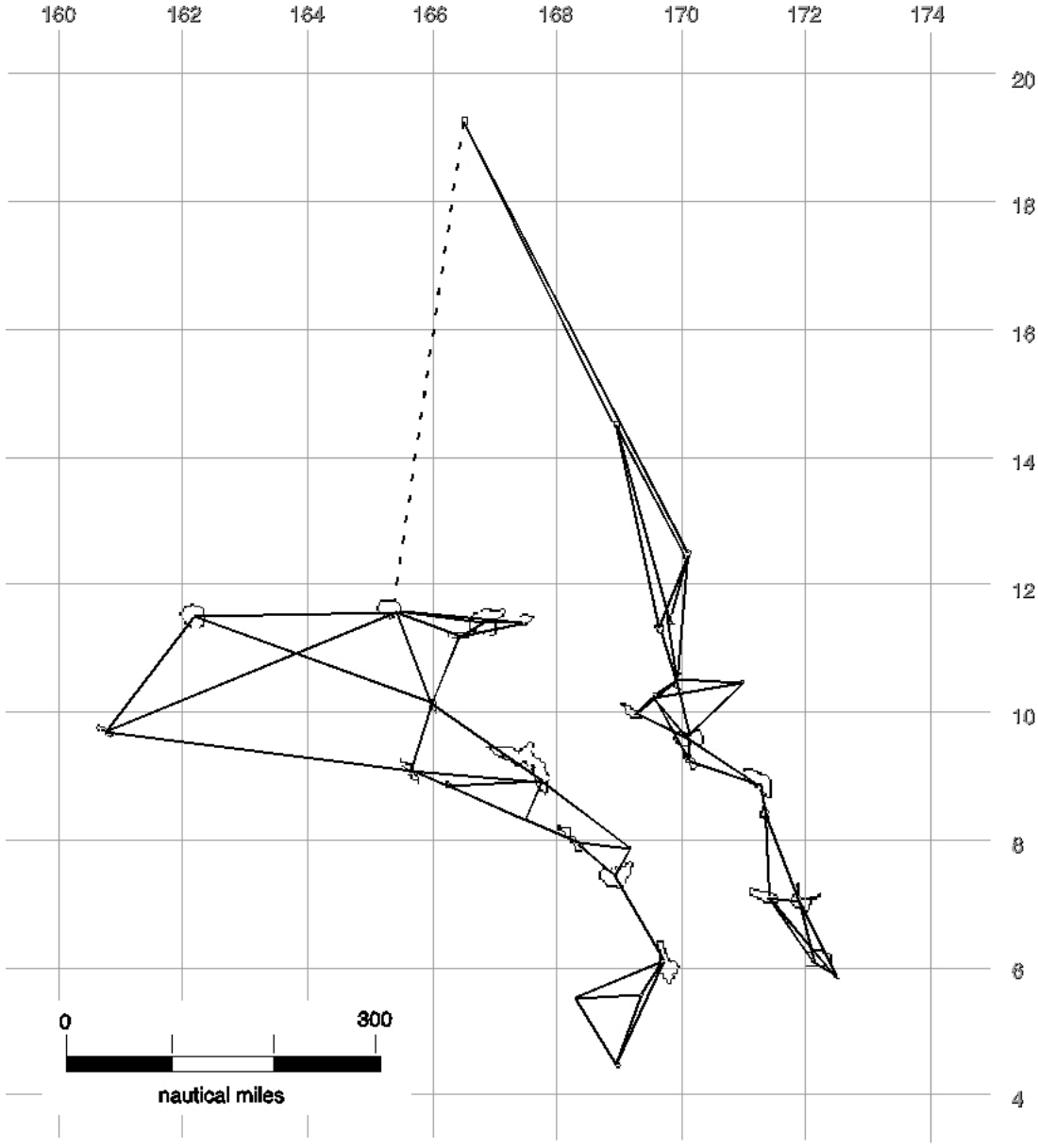

Figure 2. Network map of the Marshall Islands based on the third proximal point analysis.

An underlying assumption, however, is that all atolls were in fact inhabited. While during the nineteenth century permanent habitation may not always have been the case on *all*, biographical evidence shows that the atolls had been utilised (Table 4). Thus all atolls were included in the analysis. On each atoll the geographical position of the larger islands, which provided for a permanent groundwater lens and better vegetation, and thus more favourable conditions for human habitation (Spennemann 1990), varies between east and west as well as north and south. The specific location of these islands, as well as the location of the deep passes through the reef platform, which allow for the passage of large canoes, have not been taken into account for the analysis carried out here. The additional distances these factors may create are actually too small to be of any concern. An exception is Kwajalein due to its outstanding size and shape. Here the distances to the northern or southern ends were used.

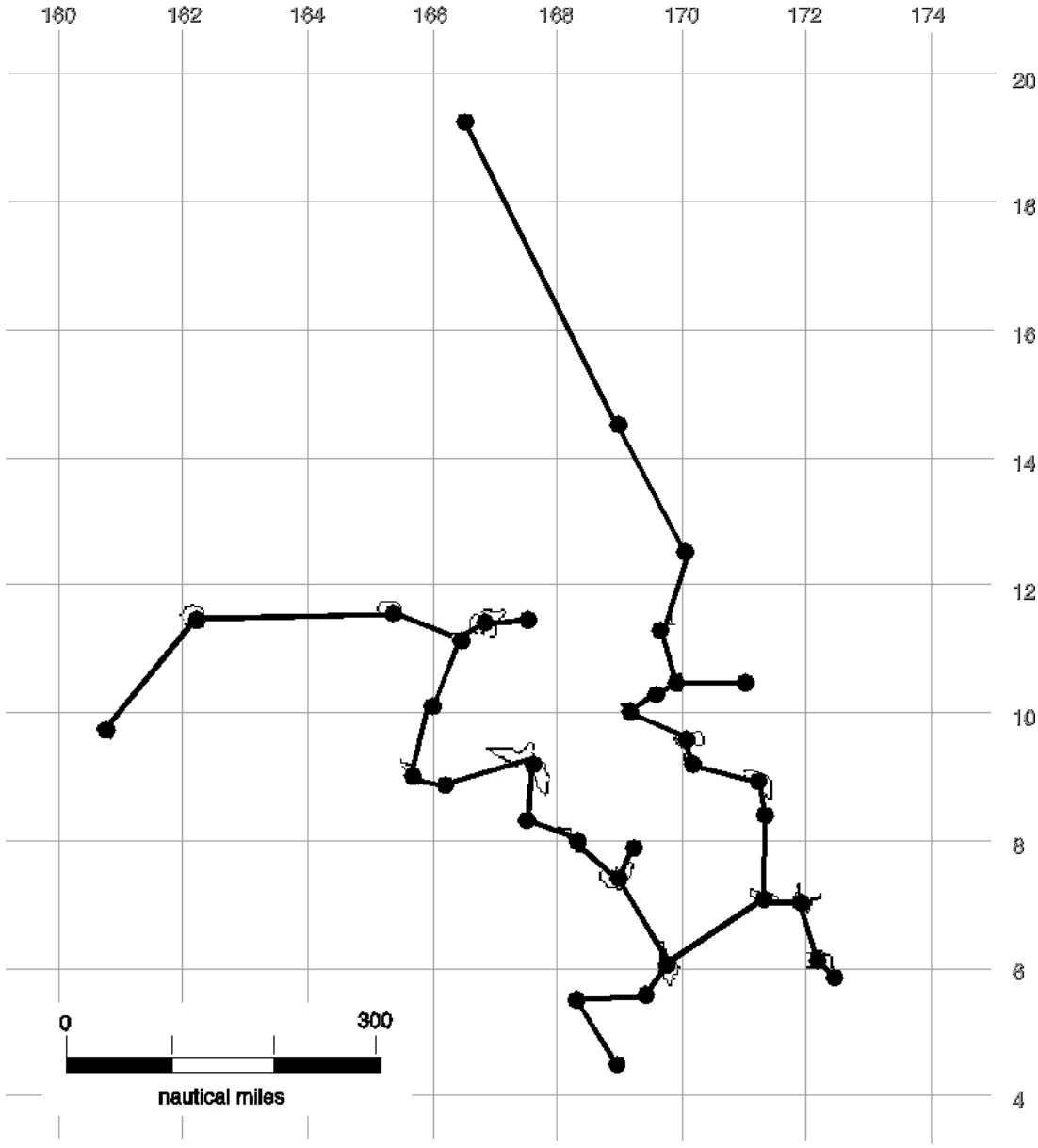

Figure 3. Network map of the Marshall Islands based on the minimum spanning tree.

The graph analysis will explore a number of analytical methods, namely third proximal point analysis, minimum spanning tree, and weighted minimum spanning tree.

Third proximal point analysis

One graph-theoretical method based on gravity assumptions is the third proximal point analysis (Terrell 1977, p. 37; Hunt 1988b). In this method lines are drawn from each point to its three nearest neighbours. This number is commonly used but as it is chosen arbitrarily, it could be increased to the fourth or fifth nearest neighbour if so desired. Connectivity with three was deemed sufficient for the purpose of the present analysis. The third proximal point analysis of the atolls shows in essence two separate networks, one running north-south in the eastern Ratak Chain and one, also predominantly running north–south in the western Ralik Chain (Figure 2).

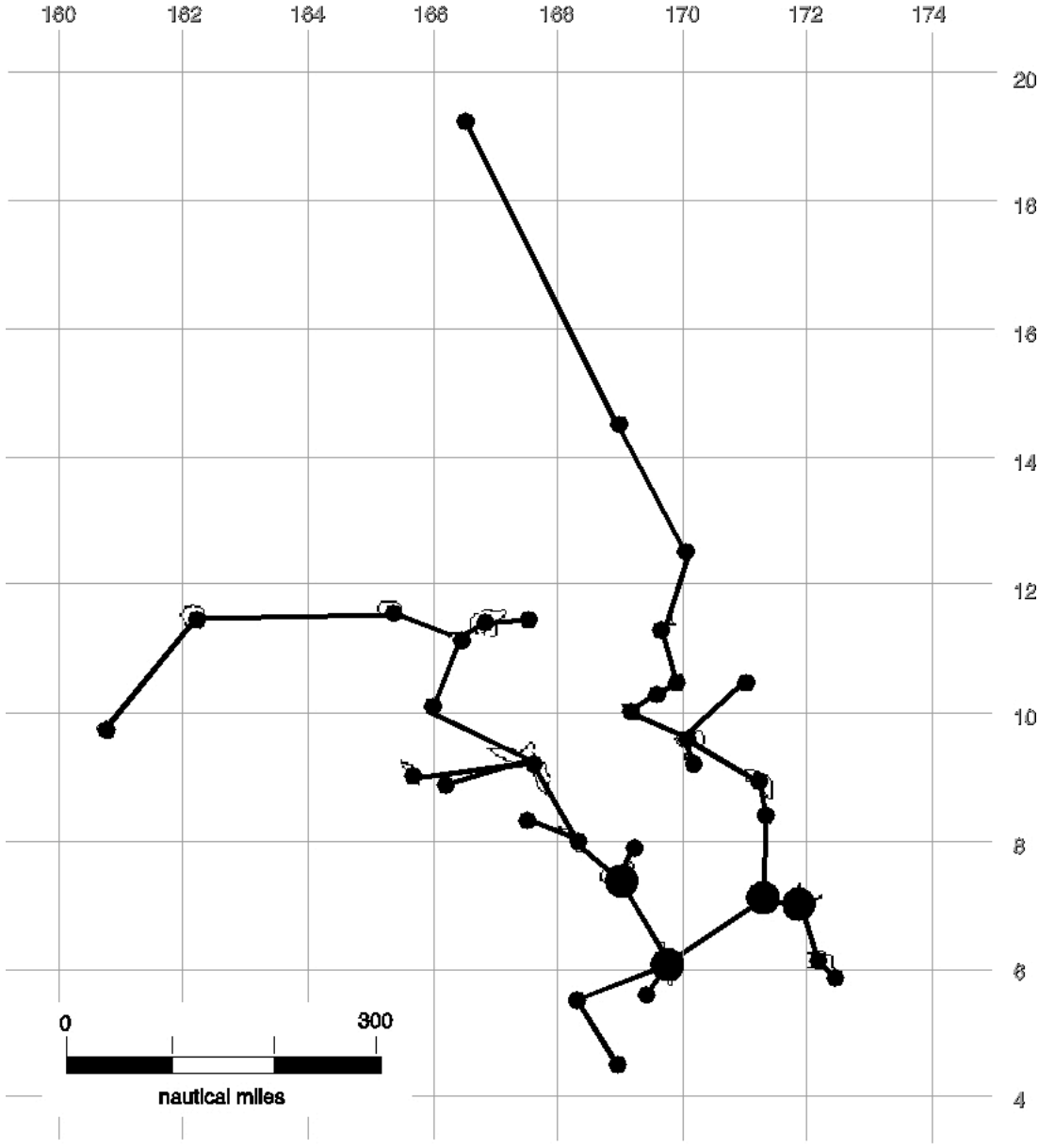

Figure 4. Network map of the Marshall Islands based on the weighted minimum spanning tree.

Both networks are connected through the northernmost atoll in the configuration, Wake (Eneen-Kio). That connection must be interpreted as an artefact of the method, as the atoll is both traditionally uninhabited/uninhabitable and the distances to that atoll are actually the furthest between each closest neighbour. When discarding the connection between Bikini and Wake as a pure artefact, then the Marshall Islands comprise of two isolated networks, confined to each of the chains. Within the chains, we note that both Ailinglaplap and Jaluit for the Ralik Chain and Maloelap for the Ratak Chain are node atolls where all communication in north-south traffic converges.

Minimum spanning tree

Following Kansky's (1963) exercise of post-dicting the evolution of the Sicilian railroad network, we can (re-)construct a network using the minimum spanning tree. This establishes the shortest path through the network with the

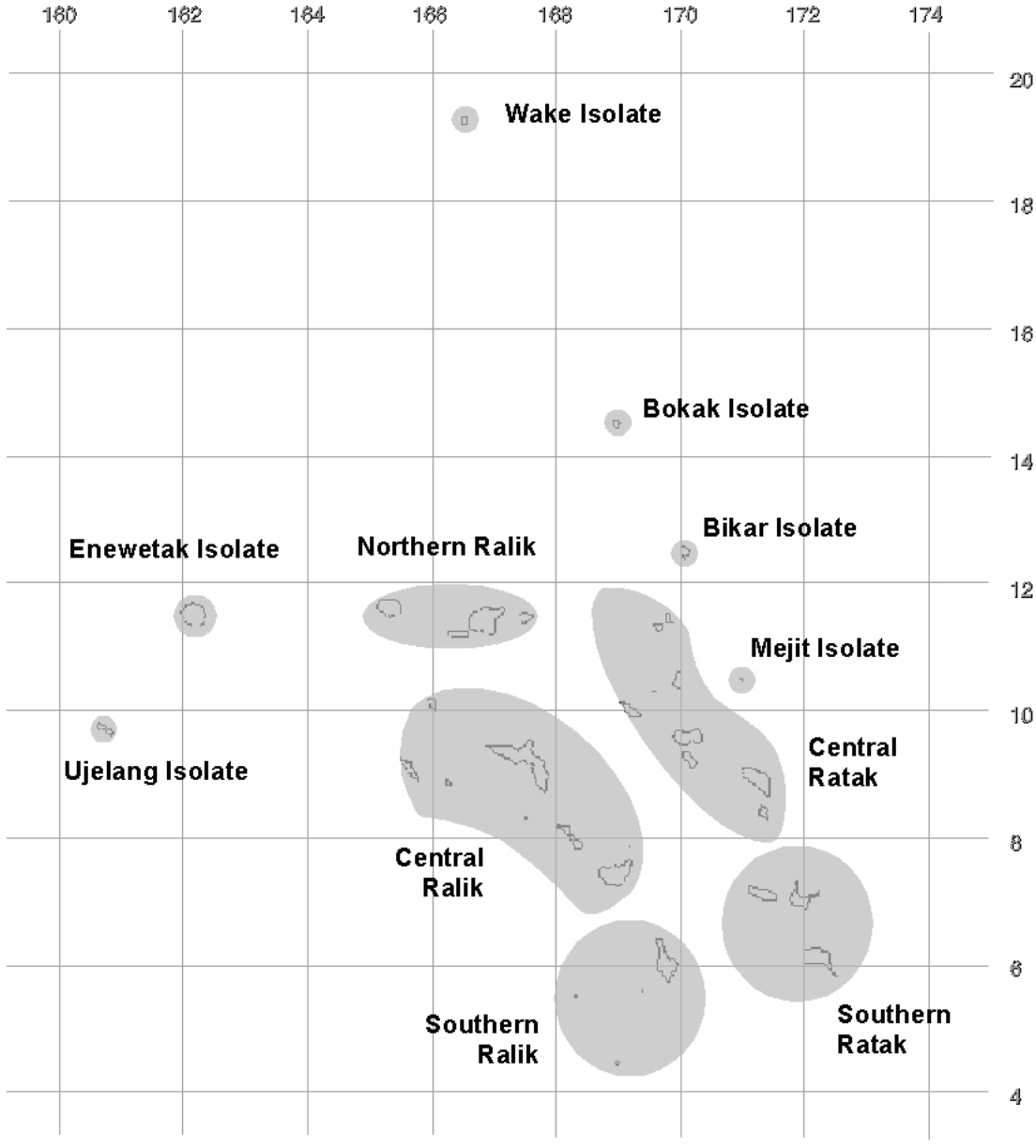

Figure 5. Communication Zones in the Marshall Islands based on network interpretation.

least number of links. First, each node is connected with its nearest neighbour. The resulting subgraphs are then linked with their respective nearest neighbouring subgraphs, until all nodes are connected (Haggett *et. al.* 1977a, p. 80).

The resulting network map (Figure 3) forms a 'U' with two networks, each running north–south through each of the chains. They are connected in the south with the gap between Jaluit and Majuro being the shortest distance between the chains. The network has four endpoints: Ujelang and Ebon for the Ralik Chain and Wake (Eneen-Kio) and Nadikdik for the Ratak Chain, but very few branches. Notable are only Mejit, Jabwat and Rongelap-Rongerik. Of these only Mejit is separated by a comparatively long leg. Moreover, Jaluit in the Ralik Chain and Majuro in the Ratak Chain assume the role of node atolls.

Weighted minimum spanning tree

Both previous models are based on the proposition that all sites are equally important. In reality this is obviously not the case, as some atolls have a greater population than others (see Figure 6). If we alter the weighting of the places based on population, the network changes as short-path connections with the more important places are pre-eminent (Figure 4). These changes, however, are only of marginal impact, with the network being straightened out and additional branches established. In the weighted spanning tree, Kwajalein and Wotje Atoll assume the role as node atolls for the chains, in addition to Jaluit and Majuro.

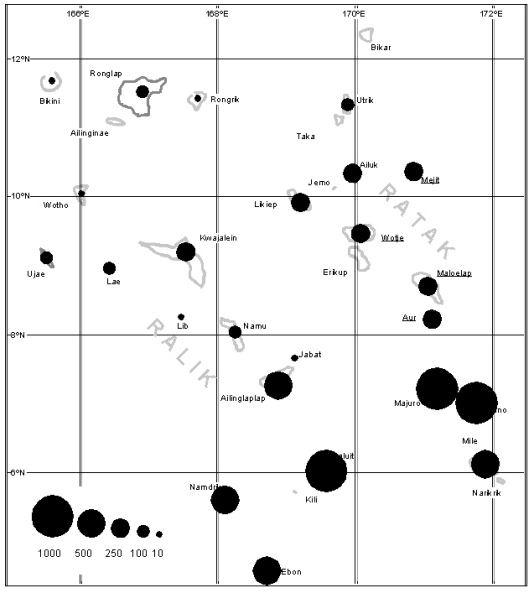

Figure 6. Distribution of population in the Marshall Islands 1910 (Spennemann 2000).

Comparison of the network models

The three network models all indicate that the connection *between* the chains was limited and of lower significance than any connection *within* the two chains. Moreover, the presence of sub-networks is evident in the graph reconstruction based on third proximal point analysis. The minimum spanning trees highlight that some of the connections, such as those between Bikini and Enewetak and then on to Ujelang, as well as those north of Uterik, are long and thus are unlikely to have been used very frequently. Another of these is the connection of the Ratak Chain with Mejit. The presence of node atolls in the spanning trees also suggests that sub-networks existed.

The available network constructions are interpreted in Figure 5, which shows the Marshall Islands segmented into five major communication zones, as well as a number of isolates.

In the following we will examine the historical, ethnographic and biogeographical evidence for connectivity in the Marshall Islands during pre-European times and the European contact period until the late nineteenth century. We will first consider the means of travel and the navigational knowledge of the Marshallese. We will then move on to examine the historic record of long-distance voyaging before we address the evidence of land and resource ownership across various separate atolls, as well as data on connectivity culled from linguistics, epidemiology, and biogeography.

THE MEANS OF COMMUNICATIONS: CANOES

The traditional canoe building in the Marshall Islands distinguishes three major canoe types based on their size and function, *walap*, *tipnol* and *korkor* (cf. Alexander 1902; Browning 1972; Erdland 1914; Finsch 1887; Giesberts 1910; Hambruch 1912; Hernsheim 1887; Hornell 1936; Jenkins 1946; Krämer 1905; Krämer & Nevermann 1938).

- The *walap*, a large sailing canoe, reaching up to 30m in length and able to carry up to 50 people and food supplies. These canoes served mainly for inter-atoll voyaging.
- The *tipnol*, a mid-sized sailing canoe, capable of carrying up to a dozen people. Built for travel and fishing in the lagoons but also short and medium distance voyaging over open water (such as from Majuro to Arno, where land is always in sight) and for fishing in the ocean.
- The *korkor*, a small rowing canoe, sometimes equipped with a sail, designed to carry up to three people. The *korkor* was used solely for fishing and transportation in the protected waters of the lagoons. On calm days it is also used for fishing on the ocean-side reefs.

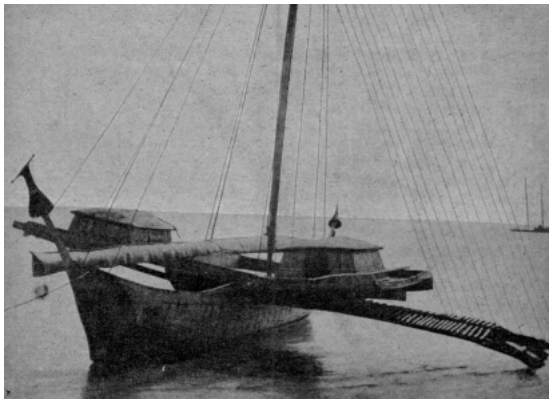

*Figure 7. Traditional voyaging canoe (*walap*) in Jaluit Lagoon about 1900 (Seidel 1902).*

These three types of canoes were also made in a variety of designs. Traditionally, five designs have been recognised: *taburbur, malmel, mwijwitok, tojeik* and *jekad.*

The canoes consisted of a hull made from a dug-out breadfruit tree or, less frequently, a drift log, with hull parts which were sawn onto the dug-out hull to heighten the boards. A large outrigger wss placed on one side of the hull.

The hull was asymmetric along the long axis, with the flatter side of the hull facing the outrigger, which allows a canoe to be sailed close to the wind. Bow and stern of the canoe are identically shaped. The mast is stepped at the bow of a canoe. In order to tack, the mast was unstepped and moved to the stern, which now became the bow. This maneuvre ensured that the outrigger always faced the wind.

Early descriptions mention that the canoes could easily carry some thirty people over great distances (Chamisso 1910, pp. 166-167; 1986, p. 133). While the sails, made of individual woven *Pandanus* mats stitched together, were sturdy and flexible, they were also heavy. In the case of rain the weight of the sails could increase to such a degree that the stability of the canoe could be endangered. Even if the wind did not cause this to happen, wet and heavy sails slowed down the progress of a canoe. Moreover, once wet, woven sails did not dry out very quickly. Thus sails would normally be stowed in the event of rain. Once that happened, the canoes would be at the mercy of the ocean currents.

Figure 8. The Neptun*, a typical trading schooner operating in the Marshall Islands at the end of the nineteenth century.*
Photo: Micronesian Area Research Center, Guam.

After European contact, the *irooj* used their wealth to their advantage and purchased, *inter alia* European-style sailing vessels for inter atoll transport. The increased carrying capacity of the European vessels, as well as the perceived prestige derived from owning such a ship, contributed to the rapid decline of the Marshallese inter-atoll sailing canoes.

In 1879 Finsch observed that long-distance canoe travel was becoming rare. By the late 1880s travel with European vessels, either run by German and British trading companies or owned by Marshallese chiefs, was rapidly becoming the mainstay of transportation. Hernsheim (1887, p. 304) mentions for 1885 that the three wealthiest *irooj* of the Marshalls each owned a European schooner. In the 1900s, the German Government required the registration of all vessels in the Marshalls, which gives us some indication of local ownership. By 1910 most *irooj* owned at least a small European-style sailing schooner (Giesberts 1910).

TRADITIONAL NAVIGATION

Micronesians are well known for their skills in long-distance voyaging and open sea navigation based on stars and wave patterns (cf. Hambruch 1912). The latter method was the mainstay of navigation on the atoll world of the Marshalls, facilitated by the large number of atolls, which broke the trade wind-driven swell and created complex patterns of wave refraction and reflection (see Browning 1972; Davenport 1960; 1964; deBrum 1962; Erdland 1914; Hambruch 1912; Krämer 1905; 1906; Krämer & Nevermann 1938; Laubenfels 1950a; 1950b; Lewis 1972; Schück 1902; Winkler 1899a; 1899b).

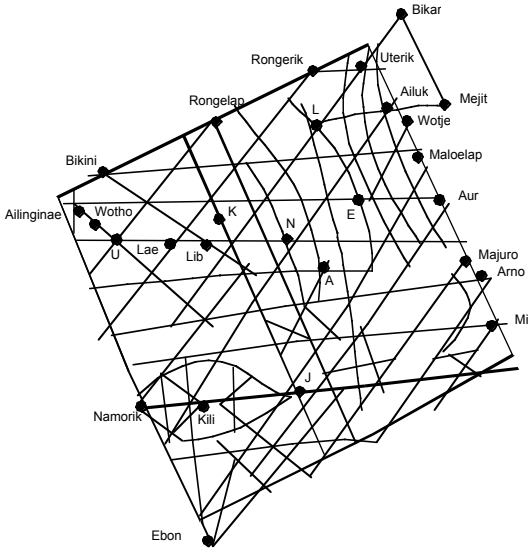

Figure 9. Schematic representation of a rebbelib *overview stick chart covering most of the Marshall Islands (collected by Robert Louis Stevenson on Jaluit in 1889). Abbreviations: A–Ailinglaplap; E-Erikup; J–Jaluit; K-Kwajalein; N-Namu; L–Likiep; U–Ujae.*

Traditional navigation entailed the memorisation of these patterns in their relative sequence and position to each other. For purposes of memory and teaching, the Marshallese navigators designed charts made from the midribs of palm fronds and Pandanus splines, with shells as place markers for the atolls ('stick charts'). These charts provide information on the relative placement of atolls, wave node points and sea markers, but do *not* give absolute locations. Moreover, many are uni-directional and focussed on specific atolls.

In addition to major overview charts (Figure 9), there are a number of smaller regional charts. Schück (1902) in his monographic treatment of the stick charts shows nine images of stick charts that deal with the navigation in the southern Ralik Islands from Ebon to Ailinglaplap. Some of them also include Mili as a reference point. In addition, there are charts that extend the whole length of the Ralik Chain, as well as special charts that allow for the navigation in the northern Ralik Chain.

The coverage of some of the charts has been plotted in Figure 10. As the majority of the charts has been collected on Jaluit, the centre of the commercial activity as late as the German colonial administration, the available sample is somewhat biased. In view of this a statistical analysis of the frequency with which the atolls appear on the stick charts would be flawed. Absent are detailed navigation charts for the Ratak Chain, which is likely to be an artefact of the Jaluit-centred collection activities of ethnographers and German traders and officials.

INTERNAL COMMUNICATIONS

Inter-atoll communications by the Marshallese does not figure in the European accounts unless it was usual in number or occasion.

The earliest commentary on internal communications is provided by members of the Russian Exploring Expedition, which visited Wotje and other atolls of the Ratak Chain in 1817. Both the commander of the expedition, Otto von Kotzebue, and the expedition's naturalist, Adelbert von Chamisso, comment on the warfare in the Ratak Chain during that period.

Wotje at the time of their visit was under the rule of Lemari. Originally from Arno, Lemari had killed the chief of Aur and thus conquered the traditional power centre in the central Ratak Chain. From there he had built up a small empire based on military prowess. When the *Rurik* came to Aur, Lemari himself was away in the northern reaches of the Ratak Chain, recruiting forces for a planned attack on the southern atoll of Majuro (Kotzebue 1821,

vol. 2, p. 87). Clearly, the structure of acquisition ran within the Ratak Chain, rather than across to the Ralik Chain.

Eisenhardt, shipwrecked on Ailuk Atoll in 1871, wrote in his account:

> "They have intercourse only with the inhabitants of another of the Marshall Groups, an island approximately 150 sea miles distant. They visit this group only once a year. For that occasion they wait for good weather. The whole population goes along, only the very aged remain behind with one chief" (Eisenhardt 1888).

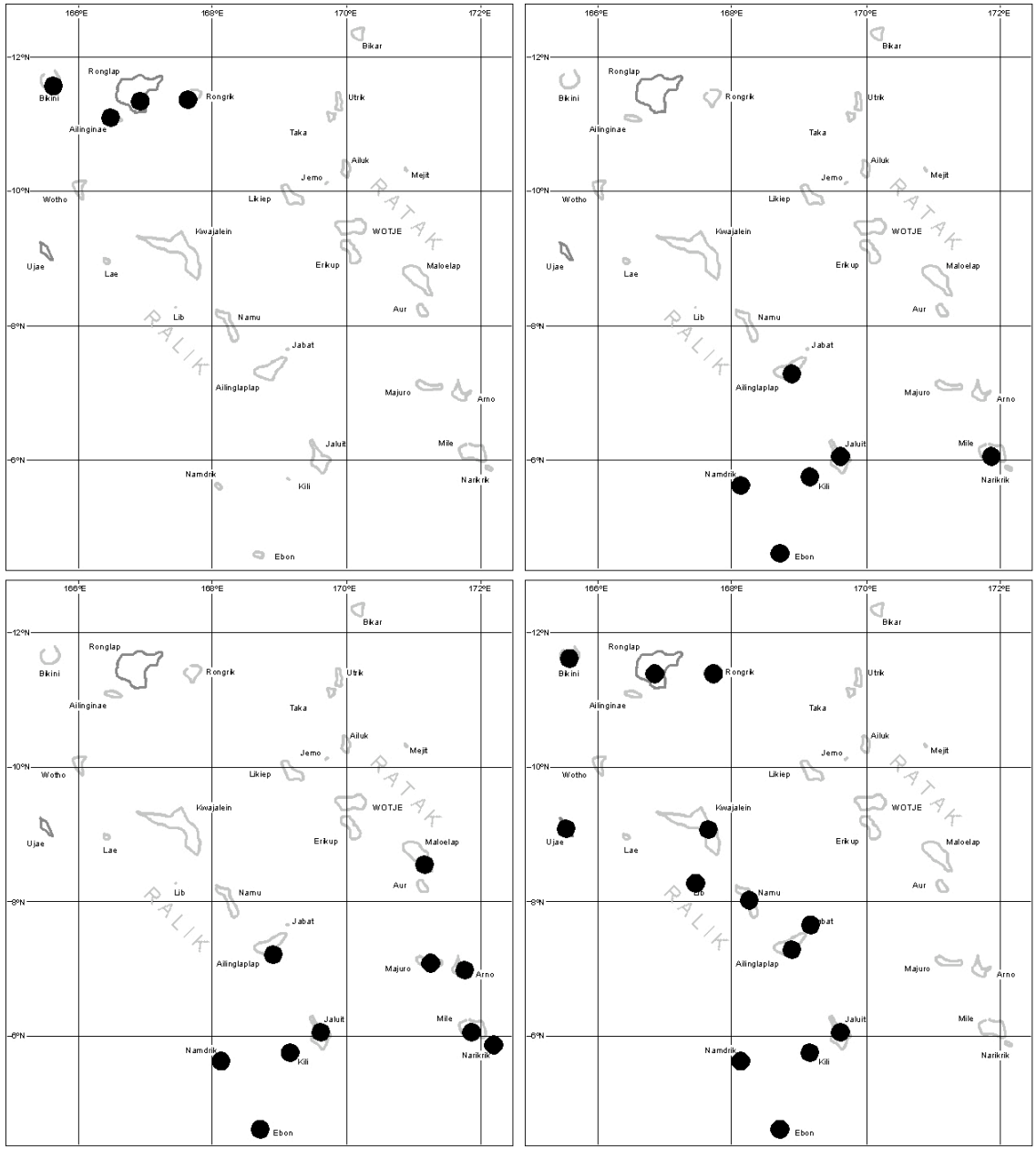

Figure 10. Patterns of islands represented on stick charts reproduced in Schück 1902.

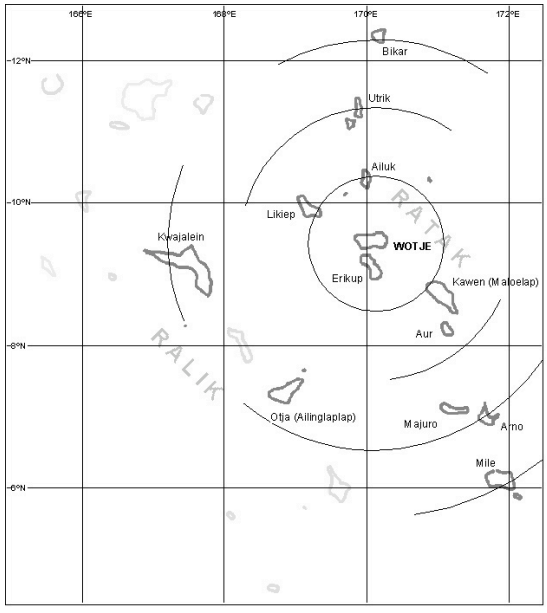

Figure 11. Map of the Marshall Islands illustrating the geographical knowledge of Lagediak of Wotje with canoe-sailing distances in days (concentric circles) (Spennemann 2004).

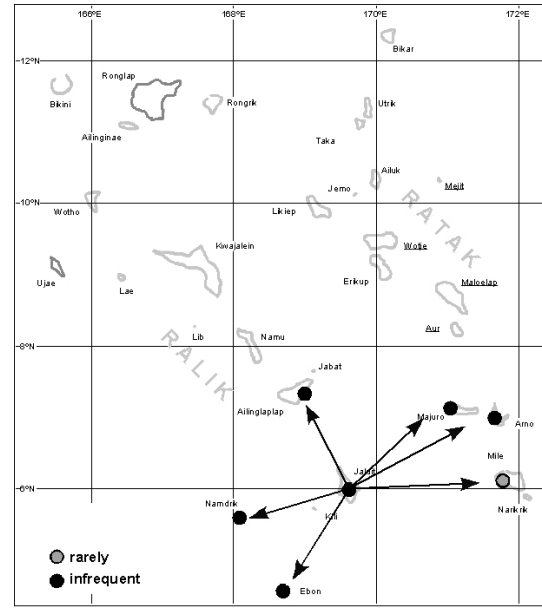

Figure 12. Map of the Marshall Islands illustrating the range of Jaluit canoes in 1879.

This was in essence the payment of obligations to higher-ranking chiefs, most probably in the form of arrowroot starch (Spennemann 1992), mats woven from *Pandanus* leaves (Heger 1886) and dried *Pandanus* paste (Krämer & Nevermann 1936). The larger islands nearest to Ailuk, *ie* Likiep and Wotje, are both less than 60 nautical miles away. A distance of 150 nautical miles fits Aur Atoll, unless it is based on a major miscalculation of distances.

The German ethnographer Otto Finsch, travelling through the Marshalls in 1879, mentions that long distance voyaging was on the decline at that time. Voyages from Jaluit went to Ebon, Namorik, Majuro, Arno, Ailinglaplap but only rarely to Mili (Finsch 1887). By the first decade of the twentieth century canoe voyaging had essentially terminated, being restricted with the lagoons of atolls, as well as between close-by atolls, such as Arno, Majuro and Mili (Giesberts 1910).

Travel times

There are a few data available on actual travel times between the atolls. In 1817 Lagediak of Wotje informed the Russian Otto von Kotzebue on the sailing times relative to Wotje (Figure 11).

Normal travel times between Arno and Mili, for example, was reported as one day (Rife 1907). In adverse winds, however, this could be considerably longer. The Protestant missionary Charles Rife, for example, narrates a voyage in 1906 that took 12 days and covered some 400 miles of sailing. Finsch (1887, p. 500) reported travel times stating that it took two days from Mili to Jaluit and also two days from Jaluit to Kili. Erdland (1904) mentions a standard travel time of three to four days from Ebon to Ailinglaplap, and a travel time of two days from Likiep to Ailinglaplap (compiled in Figure 13).

The Marshallese navigator Lagediak of Wotje also provided the Russian Otto von Kotzebue in 1817 with information on atolls he knew of, with their position relative to Wotje and their distances. Mentioned were most of the atolls of the Ratak Chain, as well as Kwajalein and Ailinglaplap of the Ralik Chain (Figure 11).

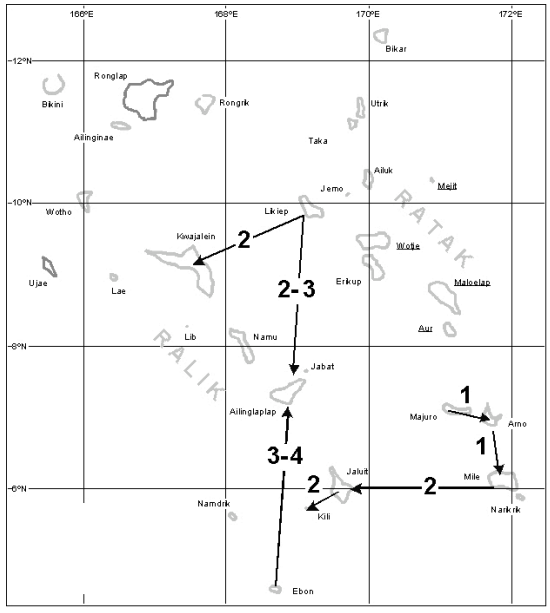

Figure 13. Travel times between atolls as reported in the late nineteenth century.

Marshallese concepts of their islands

The Marshallese never had a fixed term comprising *all* the atolls which today make up the Marshall Islands. The Marshallese had no perception of the atolls of the Marshall Islands as a geographical entity differentiated from other surrounding entities. They called them *Aelon Kein Ad*, "our atolls" and called themselves accordingly: *Armij Aelon Kein*, "people of these islands" (Senfft 1903). Concepts of nationhood or statehood were alien in a environment dominated by the sea—and by the invaguaries that sea travel could entail.

In the past, there was no need for such delineation, as the sea of the Marshallese ended, where that of other adjoining cultural groups began. Culturally and genealogically the Marshallese were a rather homogenous group of people, more so than most other Micronesian populations. Within the Marshall Islands, the traditional differentiation was based on a clan system (cf. Erdland 1914), rather than geographically. Thus saying one is from Arno Atoll makes little sense in view of the fact that one also has resource, and often land-rights one way or another on other atolls.

The Europeans gave both chains a general name, "Marshall Islands", coined in 1788 by Captain Thomas Gilbert of the British transport *Charlotte* in honour of his fellow Captain William Marshall, in charge of the accompanying transport *Scarborough*, who sailed as convoy from Port Jackson to Canton in China (Gilbert 1789).

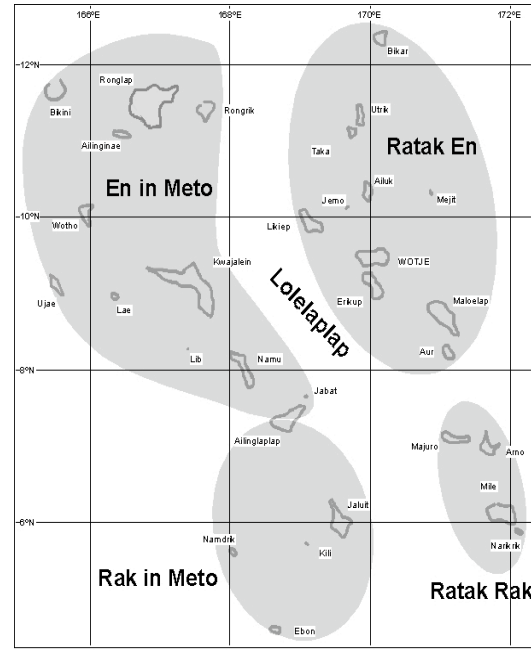

Figure 14. The Marshallese Geography of the Sea set out in broad terms (based on Krämer & Nevermann 1938; Nakayama & Ramp 1974).

For the Marshallese, the atolls of the northern Ratak Chain, north of Majuro and Arno, and including Bokak and Eneen-Kio was *Ratak En*. The sea north of Bokak and Bikini was *Joiiaenkan* (Nakayama & Ramp 1974, p. 85). According to Erdland (1914, p. 205) the sea north of the Ralik Chain (=north of *Joiiaenkan* ??) was called *patpat* (swamps) because it was believed that the sea would end in a swamp.

The sea area around Majuro, Arno, Mile and Nadikdik (Knox Atoll) was called *Ratak Rak*. The territory around Ebon, Namorik, Jaluit, Kili and half of Ailinglaplap was named *Rak in meto*, while the general name for the northern rest of the Ratak Chain was *En in meto*.

The sea between the Ralik and Ratak Chains was called *Lolelaplap* or *Loluilaplap* (Erdland 1906, p. 172; 1914, p. 4).

Landmarks on the open sea

As with most Micronesian atoll populations, the Marshallese were superb seafarers who ventured far. Inter-atoll voyages comprising some 300-400 people are on the record (Hezel 1983; Krämer & Nevermann 1938, p. 30; Gulick 1862).

The Marshallese not only knew how to find their way around the atolls which make up the—modern—Marshall Islands, but were also cognisant of other islands, several small shoals and patch reefs well beyond the margin of the Ralik and Ratak Chains. Several of these seamarks are known from traditions and can be correlated with known shoals and reefs (Table 2). Others cannot be located on modern maps, and are likely to be intersections of currents and deflected swells, upon the knowledge of which the Marshallese navigation largely depended.

These sea marks are plotted in Figure 15, as far as they can be placed on the map. It is worth noting that these seamarks are in essence arranged in an arc around the northern atolls, as well as south-west of the southern end of the Ralik Chain and south-east of the southern end of the Ratak Chain. While there may have been more sea marks known to the experienced navigators, it was these that were still well known when the European visitors started to document them. This would suggest that it was these that were of great significance. Indeed, the northern sea marks provide the navigator with clues to the approach to Wake Atoll in case the direct approach failed. The same applies to the sea marks on the southern end of both chains. All provided the navigators with positions in case they had missed the islands they had aimed at.

Beyond these sea marks, however, lay the open sea and the islands and atolls of other peoples.

Table 2. Marshallese sea marks other than the atolls of the Marshall Islands (see figure 2) (based on Krämer & Nevermann 1938; Nakayama & Ramp 1974).

Name	Translation	Type of sea mark	Modern name on charts	approx. location
Aeboj En	fresh water well	reef		southwest of Ebon
Ak Leotutu				east of Wake
Jere Akeo				west of Bokak & northwest of Bikini
Jirurulon				southeast of Ebon & south of Mile
Joiiuenkan	flight of the great frigate bird	sea mark		west of Wake & northwest of Bikini
Jomaj				east of Jaluit/Namorik
Langa		reef	Keats Bank	90 nm east of Mile
Lijinmaj				east of Jaluit/Namorik
Lijinmaloklok		wave node		west of Ebon/Namorik
Limerwitip		sea mark		east of Bokak, also leeward of Mejit
Limlim en Enewetak	the white (foam) near Enewetak	wave node		two days north of Enewetak
Limudjalili		reef		north (northeast) of Arno
Lukwejeja	middle of nowhere	reef	near Neptune's Bank	[20 nm] east of Arno
Mermerkan Ruo	the two foams	wave node		south of Mile
No		reef?		between Arno & Mile
Tokomule				southeast of Mile
Voren kobeguidj kan		reefs		three days north of Bikini
Voren lal	pound the bottom	reef	Neptune's Bank	[33 nm] east of Arno

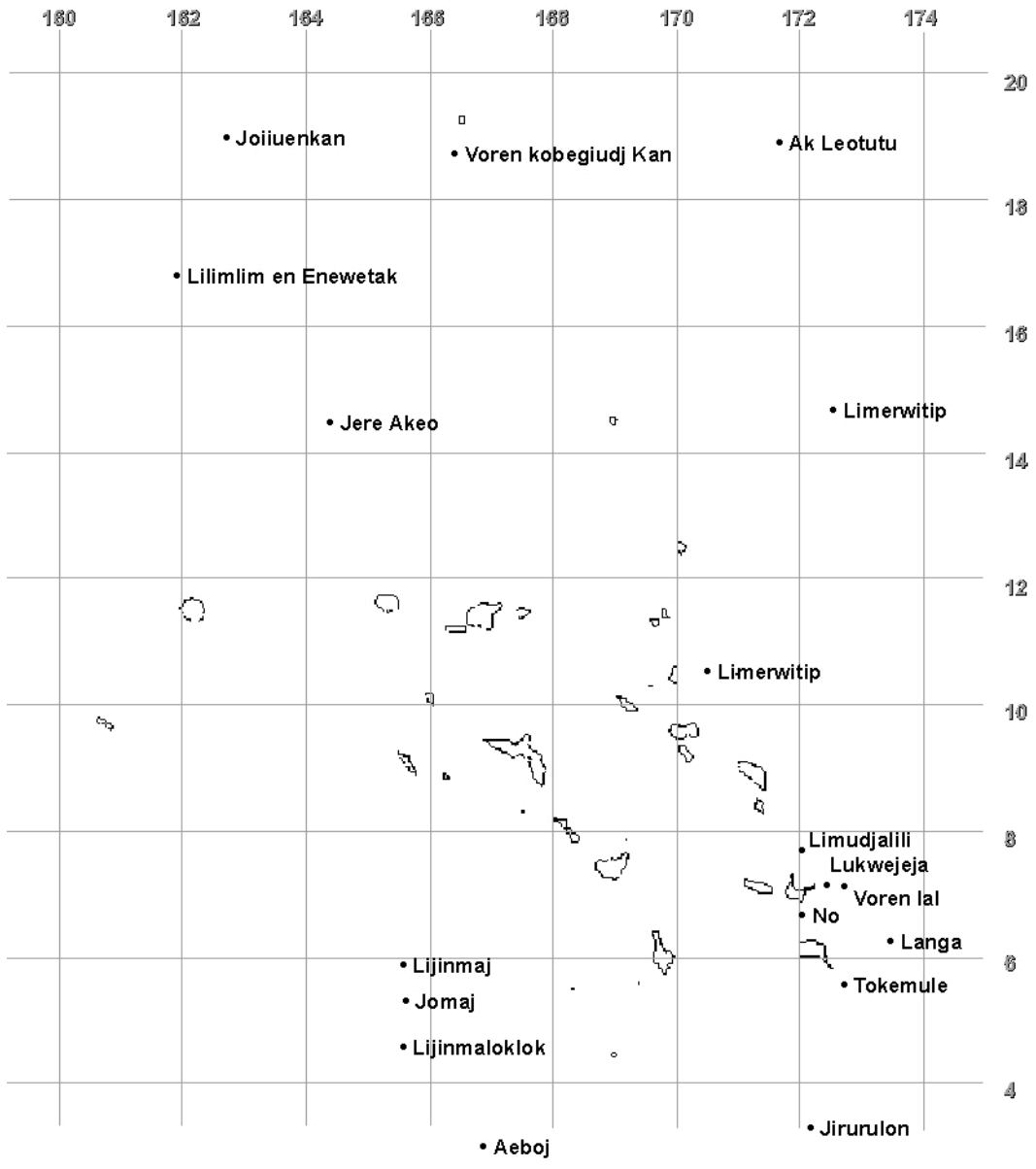

Figure 15. The atolls of the Marshall Islands and the approximate location of Marshallese seamarks.

EXTERNAL COMMUNICATIONS

The world they knew about, however, was considerably larger, as they were in contact with the people they had visited, as well as with the people who had visited them either intentionally or accidentally, namely Carolinians and i-Kiribati.

The Marshallese □□ □ , the world of which they were aware, ranged from at least Kosrae and Pohnpei, and possibly Yap in the west, to central Kiribati and Banaba (Ocean I.) in the south, Eneen-Kio in the north and probably Johnston in the east (Krämer & Nevermann 1938, p. 217; Nakayama & Ramp 1974, p. 6;7;84). Rather well known were Mokil and Ngatik in the central Carolines, as traditions claim frequent wars with these atolls (Krämer & Nevermann 1938, p. 217) as well as Pingelap.

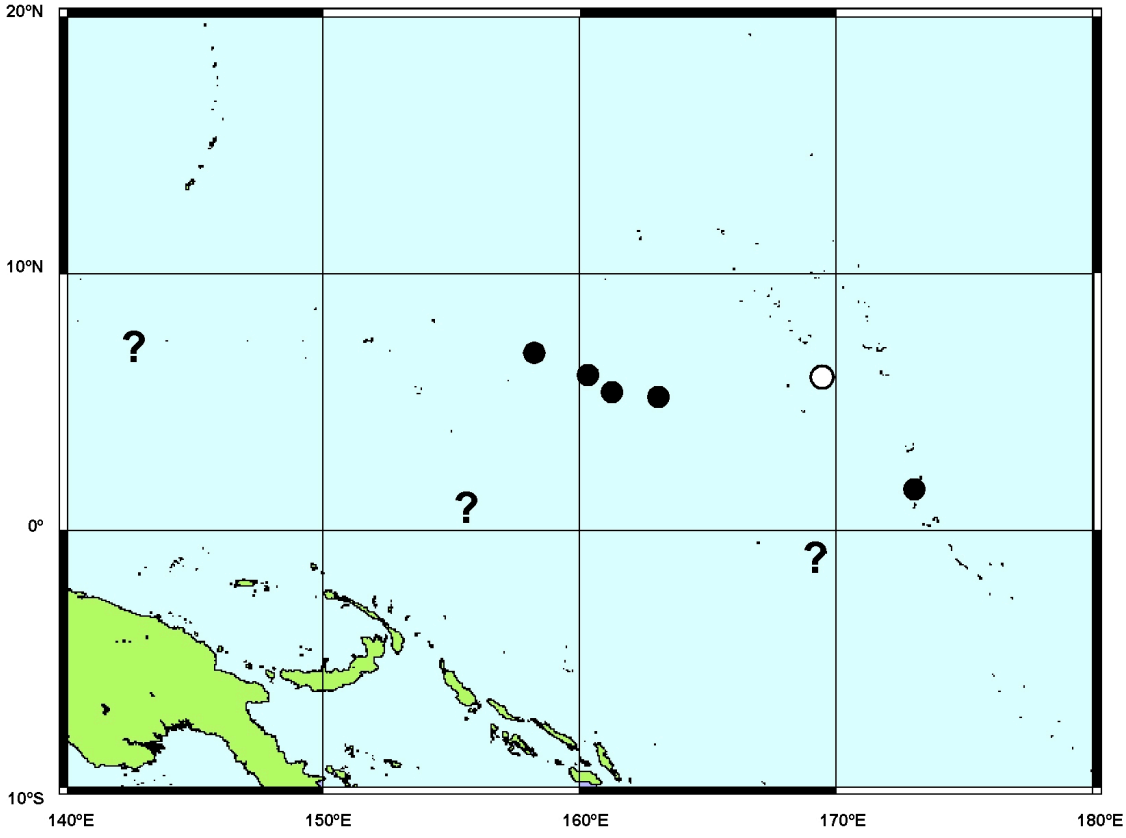

Figure 16. Locations to which Marshallese canoes are known to have sailed (Jaluit Atoll shown as open circle, claims shown as question marks).

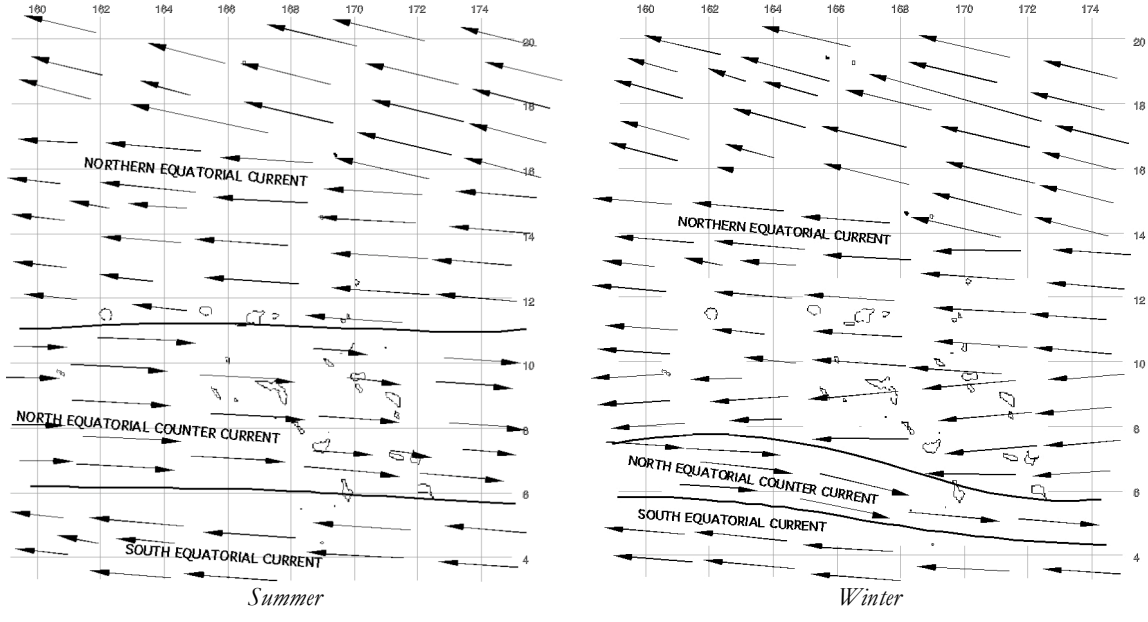

Figure 17. Current patterns in the Marshalls.

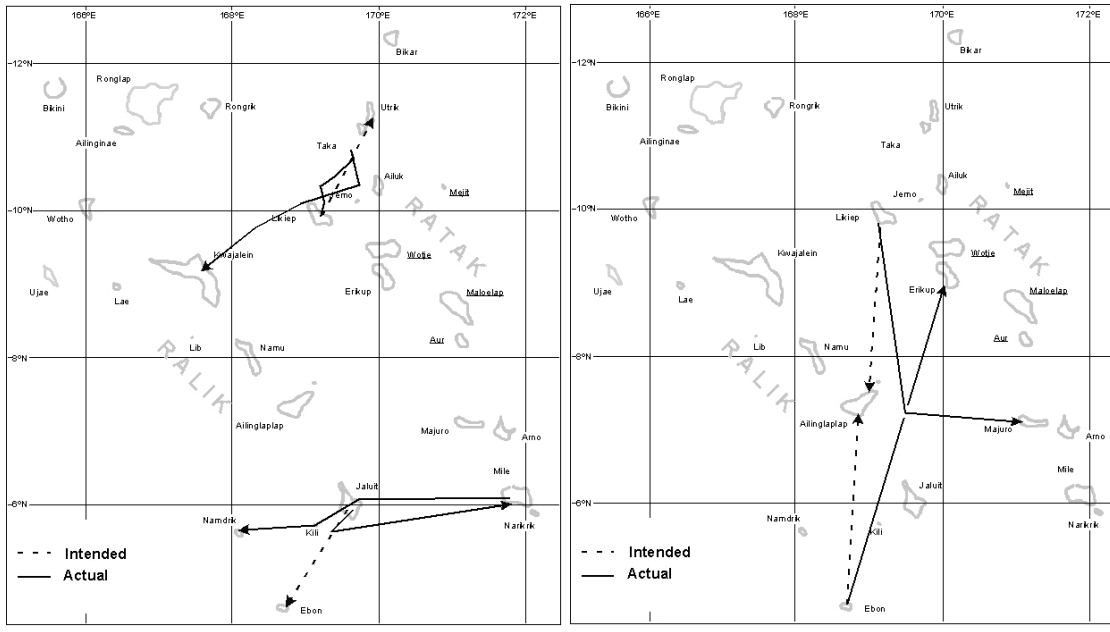

Figure 18. Examples of drift voyages and navigation errors within the Marshalls (see text).

Other oral traditions indicate that on occasion voyages may have occurred as far afield as Kapingamarangi and Nukuoro. At about 1860 it is said the people from Majuro Atoll set out with 50 canoes to conquer Kapingamarangi Atoll, a Polynesian outlier in the southern central Caroline Islands. Upon arrival the Majuro people killed all original inhabitants and left a colonisation group behind. On the way back the canoe fleet ran into a severe storm and was dispersed. Some of the canoes ended up in Pohnpei, while others were driven to Nukuoro Atoll. There, again, the Majuro people killed all original inhabitants and installed themselves as the owners of Nukuoro. Krämer and Nevermann (1938) who report this story, however rightfully question its accuracy on linguistic grounds, as the Nukuoro and Kapingamarangi people speak a Polynesian outlier dialect and not Ralik-Ratak.

Drift Voyages

In addition to their own intentional voyages, accidental dispersals carried the Marshallese far afield. While the trade winds were reliable, they could, on occasion, temporarily cease. The dependence of the canoes on wind, coupled with the presence of strong ocean currents (Figure 17), meant that canoes were often set adrift, missing the aimed at location and ending up at different islands altogether. Examples for such problems are well documented:

- Finsch (1887, p. 500) narrates an example of seven canoes which left Jaluit for Ebon in early August 1880. Having lost their way, they drifted to Mili, reaching it four weeks later. Twelve of the fifty Marshallese died of starvation and exhaustion. On 25 September, after a two days sail from Mili, now nine Jaluit canoes, accompanied by eleven canoes from Mili, reached Jaluit. On 9 October a fleet of eighteen canoes left for Ebon again, reaching Kili two days later. A storm then set the fleet off course. Tacking two and fro, searching for land, the remaining canoes eventually reached Namorik on 6 November. Four canoes became separated in the days after the storm and all on board perished.
- Giesberts (1910), a Catholic missionary on Arno and with first-hand experience on Likiep, retells the story of a 'recent' event, in which four canoes set out from Likiep to Uterik. After being becalmed, currents threw the canoe off course. After four weeks of tacking to and fro, the canoe was again near Likiep, became again becalmed,

and after a week eventually ended up at Kwajalein Atoll.

The problem was not confined to tradtional canoes, but could also beset European-built sailing vessels piloted by Marshallese navigators:

- Krämer (1906, p. 386) describes a voyage aboard the *Benak* from Likiep to Ailuk, which he wished to visit for ethnographic study. Tacking in vain for a couple of days against the trade wind—and pressed for time—the vessel eventually sailed downwind for Kwajalein.
- The Catholic priest Augustin Erdland (1904) recalls a voyage he took from Ebon to Ailinglaplap in early 1904 in order to catch a schooner that was going from Likiep to Jaluit via Ailinglaplap—a trip that normally took three to four days. Eight days after departure the vessel eventually arrived off Erikup.
- On the same trip, four days into the voyage, they spoke to a Marshallese-sailed schooner from Likiep, which had encountered a calm and, set eastwards by the North-Equatorial Counter Current, had missed Ailinglaplap. That vessel eventually reached Majuro.

Drifting to other parts of the Pacific

These mishaps not only occurred within the Marshall Islands, but also carried canoes much further afield. Blown off course and drifted by currents and trade winds, Marshallese canoes have been reported as arriving on Nauru (Hernsheim 1887, p. 303), Pohnpei (Giesberts 1910), Kosrae (in 1856; Warren 1860, p. 175; Finsch 1893, p. 166), and from as far west as Faraulep in the Western Carolines (on the schooner *Lotus* in 1879, Finsch 1887, p. 500) and Guam (Finsch 1893, p. 166). Marshallese from Jaluit, bound for Ebon, ended up 36 days later at Kavieng, New Ireland, New Guinea (Prime Ministers Department 1916).

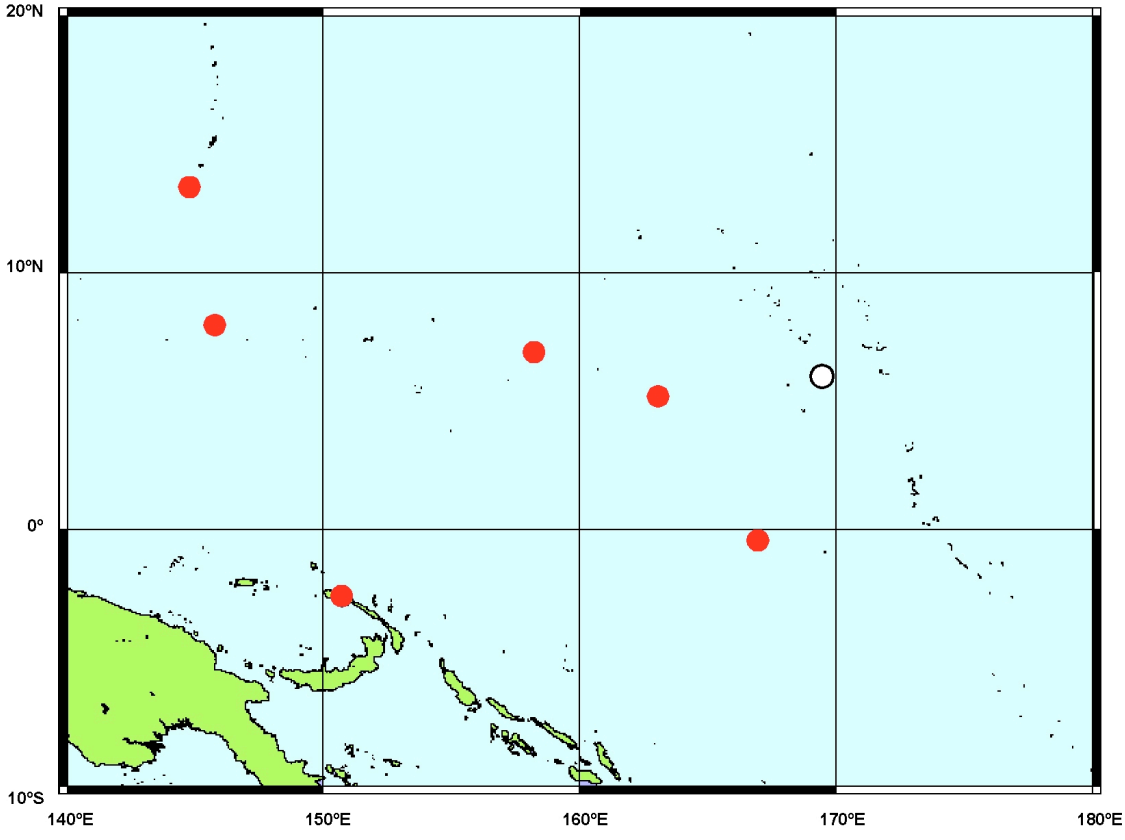

Figure 19. Locations to which Marshallese canoes are known to have drifted (Jaluit Atoll shown as open circle).

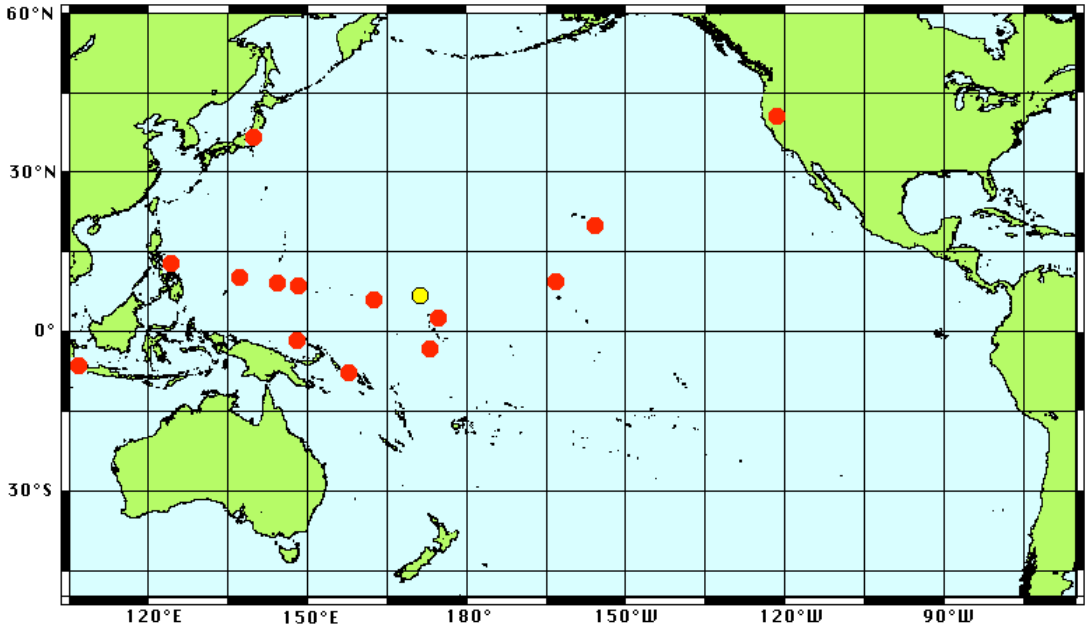

Figure 20. Origin of drift materials encountered in the Marshalls (light dot) (Spennemann 1997a).

People drifting to the Marshalls

The *central Carolinians* are credited to have regularly come east to the Ralik Chain, and sometimes as far as Johnston Atoll. The literature claims intentional voyages (Nakayama & Ramp 1974, p. 7-8; Pompey 1971, p. 13, 15, 75) and provides ample evidence for drifted voyages from Pingelap (to Jaluit, Krämer & Nevermann 1938, p. 35); Lamotrek (Kotzebue 1821, vol. 2, p. 89); and Woleai (Krämer & Nevermann 1938, p. 3; Erdland 1914, p. 315—see also Kadu of Woleai mentioned in Chamisso 1986). In the mid nineteenth century twenty Yapese drifted to Kili, where they were captured and killed by the chief (Hezel 1979, p. 127; entry for 1868, *Bark Syringia).*

The *i-Kiribati* or *ri-Pit* as they are known in the Marshalls (Krämer & Nevermann 1938, p. 13 footnote 2; 26; Chamisso 1986; Hernsheim 1887), were especially often found adrift and frequently stranded on the southern Marshalls, namely on Mile and Arno, and these atolls have several genealogical links with the northern and central atolls of Kiribati. During the nineteenth century i-Kiribati were living on Namorik (1851: Hezel 1979, p. 121; 1868: *ibid.* 127), and on Jaluit (1871: *ibid.* 129; 1879: *ibid.* 136).

In addition to intentional voyages to the Marshalls, there is a growing body of evidence that documents accidental dispersal and drifting. Elsewhere, Spennemann (1996a; 1997a) has reviewed the evidence for drift dispersal of a wide range of material (canoe hulls, pumice, drift wood etc) originating both from the west and the east (Figure 20).

Traditional Ownership

Because of the marginal nature of land on the atolls of the Marshall Islands, and the precariousness of human existence in view of typhoons (Spennemann 1996; 2004) and droughts (Spennemann 1990), it was advisable for chiefs to have a complex web of rights over land, people and natural resources, spread over more than one atoll. While the principles are well known (cf. Erdland 1914; Krämer & Nevermann 1936; Spennemann in press), the actual data we have in hand on cross-atoll ownership of land in the nineteenth century are sparse. What is know should neither be deemed complete, not should it be construed as evidence for formal land claims. Some of the data may well only be hearsay reported as fact in the historic literature. However, we know of the following nineteenth century examples:

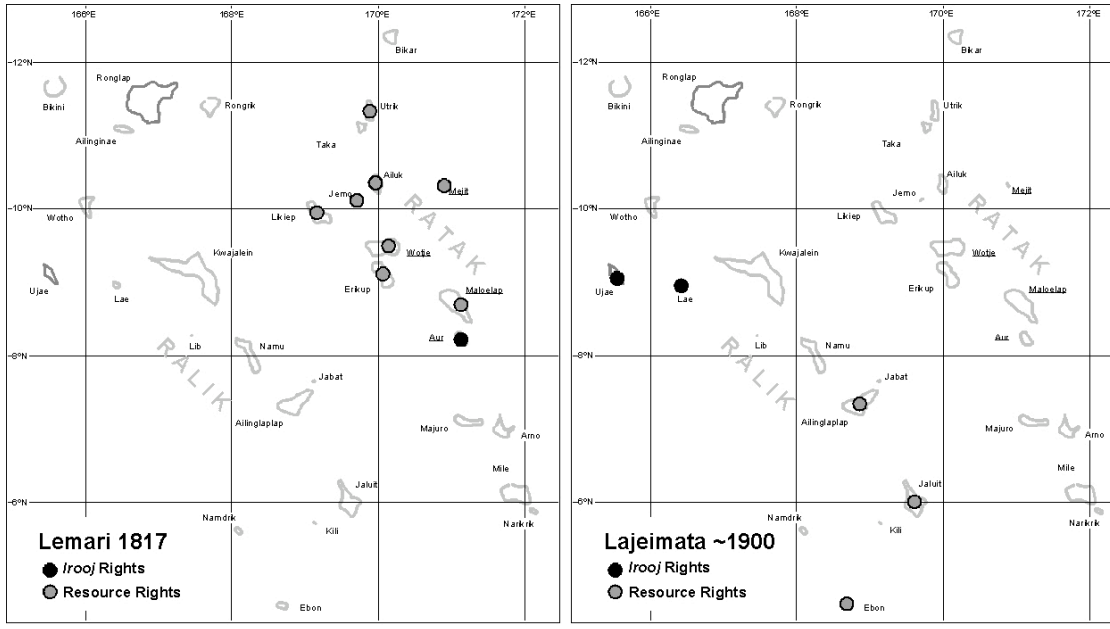

Figure 21. Examples of resource rights across a range of atolls.

- Nelu of Jaluit gave Loeak land allotments on Ebon and Ailinglaplap, reputedly in return for sexual favours of Nelu's wives (Erdland 1914, p. 99).
- Lajeimata, Kabua's son, was *irooj* on Ujae and Lae, with resource rights to Kabua's property on Ebon, Ailinglaplap and Jaluit (Erdland 1914, p. 101).
- Kotzebue (1821) comments on Lemari of Aur, with rights to all or some of Maloelap, Erikup, Wotje, Mejit, Likiep, Jemo, Ailuk, Mejit and Uterik.
- Kabua had land and resource rights on Ebon, Jaluit, Namorik and Ailinglaplap (where he was also buried) (Krämer & Nevermann 1936)
- In 1909 *irooj* Labareo of Maloelap exercised his land and resource rights and sent a sailing vessel to Bokak Atoll in the far north of the Ratak Chain to collect birds and turtle (Stuckhardt 1909; Spennemann 1998).

Traditional Obligations

Traditional inter-atoll obligations are on record for the early contact period as well as for the early German colonial period. Typhoon food shortages have always been a problem in the atolls. Traditionally in times of starvation, people would "cash in" on inter-atoll alliances and would move part of the populations to other atolls. We know that amongst others, the following reciprocal obligations existed:

- The typhoon of 1857, which seems to have devastated Ebon Atoll, resulted in severe starvation and the move of some 800 people of a total of 1300 temporarily from Ebon to Jaluit Atoll (Krämer & Nevermann 1938, p. 30).
- The movement of people from Mile to Arno, and the supply of coconuts, *Pandanus* and breadfruit preserves from Arno and Majuro to Mile after the typhoon of 1905 indicates the perseverance of such a safety network (Spennemann in prep).

LINGUISTIC DATA

Linguistically, the Marshall Islands exhibit two dialects: Ralik and Ratak. The fact that the linguistic distinction exists on lexicographic terms (Erdland 1906) as well as in terms of pronunciation (Bender 1969, pp. xii-xiii) demonstrates that while communication between both chains existed it was infrequent enough to allow for two separate dialects to develop. Furthermore,

some dialect differences have been identified *within* the chains, with Mejit in the Ratak Chain and Ujelang in the Ralik Chain standing out as isolates (Bender 1969, p. xiii).

PHYSICAL ANTHROPOLOGY

At the end of the nineteenth century, the people of the Marshalls addressed each other as *Ri-Ratak* or *Ri-Ralik* (Senfft 1903). It is unclear to what extent this was a mere geographic distinction, or to what extent this was also a representation of physical characteristics. Anecdotal evidence, for example, stresses that head shape and facial characteristics, such as the shape of eye-brows, allow people from Mejit to be readily identified in a crowd (pers. comm. Hemley Benjamin).

The extent of data provided by physical anthropological research is limited. The archaeological collections derived from early burials are small and do not allow to make any comment on population characteristics.

A somatological study by Hasebe (1938, summarised in Hunt 1950) looked at 238 male Marshallese from the Ralik and Ratak Chains. While differences were observed between the two samples, we are uninformed whether they are statistically significant.

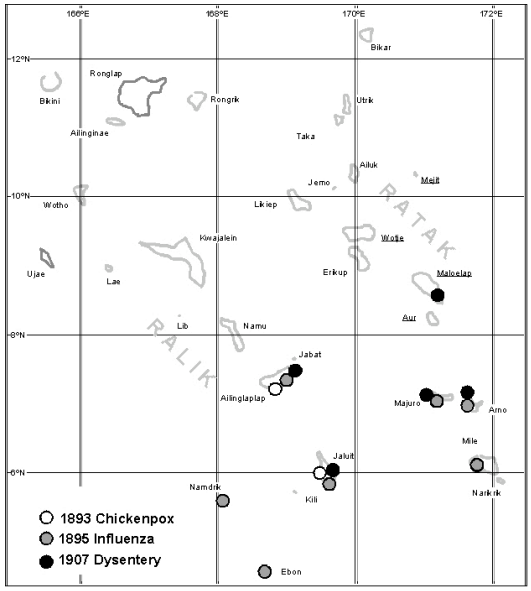

Figure 22. Spread of communicable diseases in the Marshalls.

EPIDEMOLOGY

The spread of communicable diseases in an island setting is predicated on the existence of inter-island communication. There are a number of these localised epidemics that can be identified for the late nineteenth century Marshalls.

- The German government physician Steinbach (1893a) when discussing the occurrence of syphilis mentions that it is prevalent in Majuro, Ebon and Jaluit Atolls but occurs only in limited proportions on the northern atolls, which have little communication with the former.
- In his report on the status of health in the Marshall Islands, Steinbach (1893a) mentions a chickenpox epidemic limited to Jaluit and Ailinglaplap Atolls.
- An influenza epidemic broke out in February 1895 and raged in Jaluit, Ebon, Namorik, Majuro, Arno and Mile (Anonymous 1897).
- Another influenza epidemic broke out in 1904 and raged in the southern atolls only (Erdland 1914).
- A dysentery epidemic affected the southern Marshalls, mainly Jaluit, Ailinglaplap, Maloelap, Arno and Majuro in 1907 (Erdland 1914).

Epidemiology can also be drawn on to document external communications:

- Tinea imbricata (ring worm) was reputedly introduced from Kosrae by Jibe and Lemari in the 1870s (Erdland 1914).
- According to local informants (to Steinbach 1893), Syphilis was unknown in the Marshall Islands in the first half of the nineteenth century. Voyagers from Jaluit shipwrecked in Kosrae by about 1845 and 1850 are blamed for its introduction.

While we are aware of some directions in which communicable diseases travelled within the Marshalls (Chickenpox 1895 from Arno to Jaluit; 1897 from Mili to Jaluit), we need to consider that the medical observations are all centred on Jaluit, the residence of the German physician, and that onwards spread from Jaluit to other islands is usually not mentioned in the annual medical reports.

Table 3. Epidemics recorded for the southern Marshall Islands until the end of the German Period (1914).

Year	Disease	Atolls affected
<1887	Influenza	southern atolls
1890	Measles	southern atolls
1892	Chickenpox	Ailinglaplap, Jaluit,
1895	Chickenpox	Arno, Jaluit,
1895	Influenza	Arno. Ebon, Jaluit, Majuro, Mile , Namorik
1897	Chickenpox	Mili, Jaluit
1899	Influenza	Central Ralik, Jaluit
1904	Influenza	southern atolls
1907	Dysentery	Ebon, Jaluit, Maloelap
1907	Measles	Jaluit
1907	Pertussis	Jaluit
1908	Small pox	Jaluit
1910	Influenza	Jaluit

Sources: Hernsheim 1887, p. 302; Steinbach 1893a; Schwabe 1896; 1908; Anonymous 1897; Bartels 1899; 1900; Erdland 1914, p. 17.

CONNECTIVITY IN THE 1890S

The frequency of inter atoll communications of the last decade of the nineteenth century can be assessed from the vessel movements to and from Jaluit for the years 1894–97 (AAKA 1896, 1896, 1897, 1898). As the ownership of each vessels is listed, we can filter out those owned by Marshallese. This reflects, to a degree, the last vestiges of traditional communication.

Plotted in Figure 23 is the average annual frequency of arrivals and departures of vessels. In interpreting the graphs, we have to be conscious of the fact that they (i) are based on single locality harbour statistics, (ii) provide little information on connections between atolls other than Jaluit, in particular the more northern atolls, and thus (iii) do not represent the entire networks. Nonetheless, the data show that in the 1890s, as far as Jaluit was concerned, the main connection both arriving and departing, was between Jaluit and Ailinglaplap, with more than ten vessels annually, and to a degree between Namorik and Ebon as well. The disproportionate under-representation of the other atolls is remarkable.

We can speculate that the 1890s pattern provides an impression of the communications frequency of the 1870s and 1880s networks, emphasising the heavy Jaluit-Ailinglaplap connection.

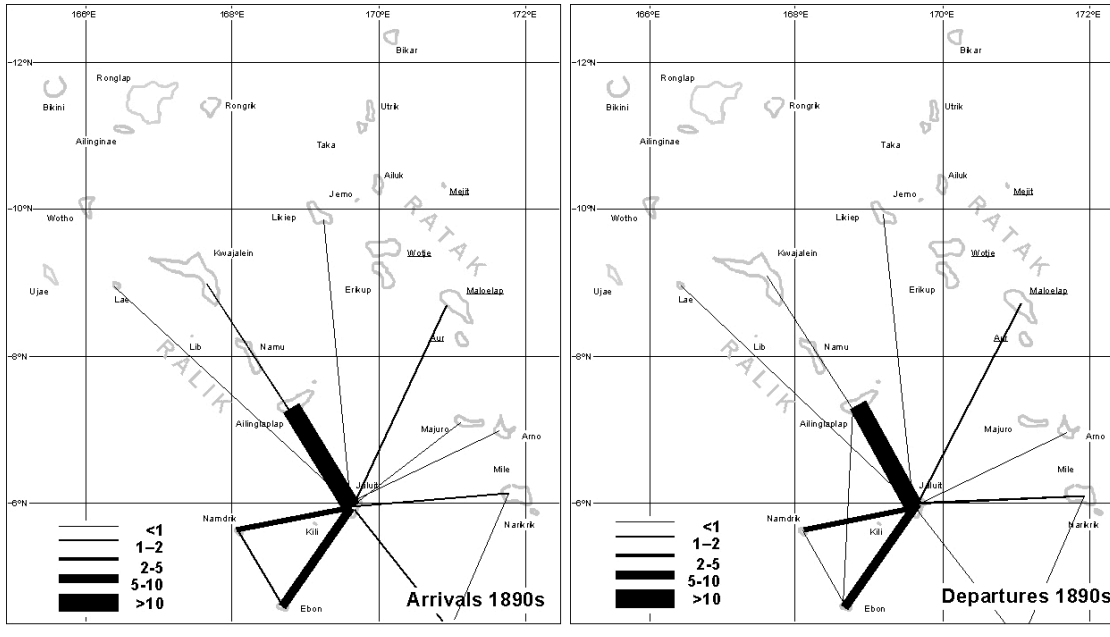

Figure 23. Origin of vessels owned by Marshallese arriving in and departing Jaluit 1894-97 (annual average).

Table 4. The occurrence of human settlement and the distribution of rodents on the atolls of the Marshall Islands (compiled from Spennemann 1997b; 2000 with additions).

Atoll	Known as inhabited	1910	*Rattus exulans*
Ailinginae			✓
Ailinglaplap	✓	✓	?
Ailuk	✓	✓	✓
Arno	✓	✓	✓
Aur	✓	✓	?
Bikar			✓
Bikini	✓	✓	✓
Bokak (Taongi)			✓
Ebon	✓	✓	?
Eneen-Kio (Wake)			✓
Enewetak	✓	✓	✓
Erikup			✓
Jabwat	✓	✓	✓
Jaluit	✓	✓	✓
Jemo			✓
Kili	✓		?
Kwajalein	✓	✓	✓
Lae	✓	✓	✓
Lib	✓	✓	✓
Likiep	✓	✓	✓
Majuro	✓	✓	✓
Maloelap	✓	✓	✓
Mejit	✓	✓	✓
Milli	✓	✓	✓
Nadikdik	✓		?
Namorik	✓	✓	✓
Namu	✓	✓	✓
Rongelap	✓	✓	✓
Rongerik	✓	✓	✓
Taka			✓
Ujae	✓	✓	✓
Ujelang	✓	✓	✓
Utirik	✓	✓	✓
Wotho	✓	✓	✓
Wotje	✓	✓	✓

BIOGEOGRAPHIC DATA

Additional evidence for the connectivity of the atolls comes from animals that are commensal with humans: rats. As rats are unable to cross larger distances of open water unaided (Spennemann & Rapp 1989), their introduction to the various atolls of the Marshall Islands has to be interpreted either as a deliberate act or as an incidence of animals stowing away (Spennemann 1997b). Table 4 sets out the occurrence of human settlement in the Marshall Islands and the presence of the Polynesian rat (*Rattus exulans)* the only species present in pre-European times. It demonstrates the presence of rats even on islands that were uninhabited at the time of the first systematic census in 1910 (Spennemann 2000). Examples for the latter are the atolls and islands of Ailinginae, Bikar, Bokak (Taongi), Eneen-kio (Wake), Jemo, and Taka.

TOWARDS A MODEL OF COMMUNICATION

Drawing together data from the various historic, ethnographic, linguistic, biogeographical and epidemiological sources discussed on the preceding pages, as well as an evaluation of the various (re-)constructions of a theoretical network based on graph theory allows us to advance a network model of communications for the Marshall Islands in (late) traditional times (Figure 24). The thickness of the lines indicates the frequency of communications along the link.

Overall, the communications network resembles the shape of a 'U' with the majority of the communications occurring within each of the two chains. The larger atolls were in frequent contact with each other, while the smaller ones were contacted via the larger population bases.

The southern, more fertile and thus more populous atolls were in more frequent contact with each other, than the less populated northern atolls.

In the Ralik Chain, the main communications links occurred between Jaluit and Ebon as well as between Jaluit and Ailinglaplap. In the northen Raliks, the atolls of Kwajalein and Wotho assume node-point status.

In the Ratak Chain these links were strongest within the Majuro-Arno-Mili triangle. Wotje seems to have assumed the role of a northern node in that chain.

Inter-chain connections occurred in the south, connecting Jaluit with Majuro and Mili. There is a possibility of a connection from either Likiep or Wotje to Kwajalein, given the ease of downwind travel, but given the evidence this is unlikely to have been frequent or bi-directional. While these connections would

have been substantially less frequent than intra-chain communications, they were nonetheless frequent enough to maintain a largely homogenous language.

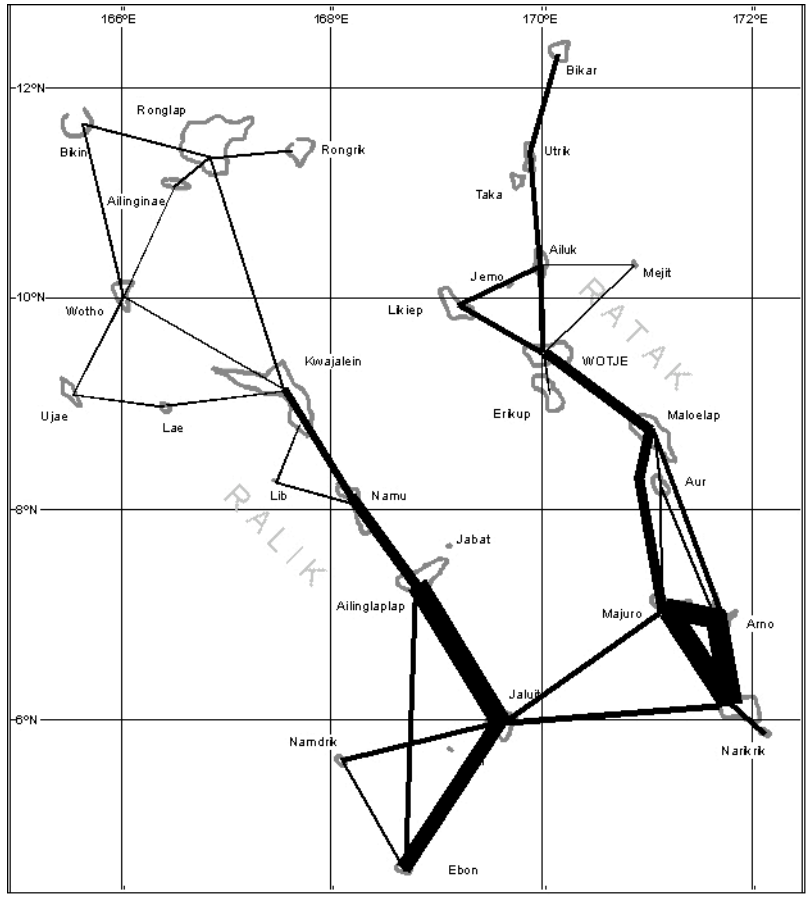

Figure 24. Proposed model of connectivity during the early contact Marshall Islands. The strength/frequency of the connections is expressed by the thickness of the lines (see text for discussion).

BIBLIOGRAPHY

AAKA (1895) Verzeichnis der im Jahre 1894 im Schutzgebiete der Marshall Inseln angekommenen und abgegangenen deutschen Schiffe. Contained in: Auswärtiges Amt, Kolonial-Abteilung. Jahresschriften Allgemeinen Inhaltes auf den Marshall Inseln. November 1894 – October 1900. Denkschriften 1h. file nº RKA 6525. National Library of Australia, Canberra. Mfm nº G8606

AAKA (1896) Verzeichnis der im Jahre 1895 im Schutzgebiete der Marshall Inseln angekommenen und abgegangenen deutschen Schiffe. Contained in: Auswärtiges Amt, Kolonial-Abteilung. Jahresschriften Allgemeinen Inhaltes auf den Marshall Inseln. November 1894 – October 1900. Denkschriften 1h. file nº RKA 6525. National Library of Australia, Canberra. Mfm nº G8606

AAKA (1897) Verzeichnis der im Jahre 1896 im Schutzgebiete der Marshall Inseln angekommenen und abgegangenen Schiffe. Contained in: Auswärtiges Amt, Kolonial-Abteilung. Jahresschriften Allgemeinen Inhaltes auf den Marshall Inseln. November 1894 – October 1900. Denkschriften 1h. file nº RKA 6525. National Library of Australia, Canberra. Mfm nº G8606

AAKA (1898) Verzeichnis der im Jahre 1897 im Schutzgebiete der Marshall Inseln angekommenen und abgegangenen Schiffe. Contained in: Auswärtiges Amt, Kolonial-Abteilung. Jahresschriften Allgemeinen Inhaltes auf den Marshall Inseln. November 1894 – October 1900. Denk-

schriften 1h. file nº RKA 6525. National Library of Australia, Canberra. Mfm nº G8606

Alexander, A.B. (1902). Notes on the boats, apparatus and fishing methods employed by the natives of the South Sea Islands. *U.S. Commission of Fish and Fisheries Report for 1901*. pp. 741-829.

Anon. (1896). Denkschrift betreffend das Schutzgebiet der Marshall- Inseln (1. April 1894 bis 31. März 1895). *Stenographische Berichte über die Verhandlungen des Reichstages. 9. Legislatur-Periode IV. Session 1895/97*, Vol. 2. Anlageband (88-286). Berlin: Julius Sittenfeld. Pp.935-938

Bartels. (1899). Ärztlicher Jahresbericht für 1897/98. *Arbeiten aus dem Kaiserlichen Gesundheitsamte* 15, pp. 363-364.

Bartels. (1900). Klima und Gesundheitsverhältnisse des Schutzgebietes der Marshall-Inseln in der Zeit vom 1. April 1899 bis 31. März 1900. *Arbeiten aus dem Kaiserlichen Gesundheitsamte* 17, pp. 558-560

Bender, Byron W (1969). *Spoken Marshallese*. Honolulu: University of Hawaii Press.

Browning, M.A. (1972). Walab im meto: canoes & navigation in the Marshalls. *Oceans*, 5(1), pp. 25-38.

Bryan, Edwin H. (1971). *Guide to Place names in the Trust Territory of the Pacific Islands (the Marshall, Caroline and Marina Islands)*. Honolulu: Bishop Museum, Pacific Science Information Center.

Chamisso, Adelbert von (1821). *Bemerkungen und Ansichten auf einer Entdeckungs-Reise unternommen in den Jahren 1815–1818 auf Kosten Sr. Erlaucht des Herrn Reichs-Kanzlers Grafen Romanzoff auf dem Schiffe Rurick unter dem Befehle des Lieutenants der Russisch-Kaiserlichen Marine Otto von Kotzebue von dem Naturforscher der Expedition Adelbert v. Chamisso, Der Philosophie Doktor, der Kaiserlich Leopoldinischen Akademie der Naturforscher, wie auch der Gesellschafter der Naturforscher zu Berlin, zu Moskau, zu Leipzig u.s.w. Mitglied*. Weimar: Gebrüder Hoffmann. 1821.

Chamisso, Adelbert von (1910). *Reise um die Welt mit der Romanzoffschen Endeckungs-expedition in den Jahren 1815-1818 auf der Brig Rurik, Capitän Otto v. Kotzebue Zweiter Theil: Bemerkungen und Ansichten. Chamisso's Werke Vierter Theil*. Berlin: G.Hempel.

Chamisso, Adelbert von (1986). *A voyage around the world with the Romanzov exploring expedition in the years 1815-1818 in the Brig Rurick, Captain Otto von Kotzebue*. (translated by H.Kratz). Honolulu: University of Hawaii Press.

Davenport, W. (1960). Marshallese Islands navigational Charts. *Imago Mundi*. (s'Gravenhage) 15, pp. 19-26.

Davenport, W. (1964). Marshall Islands Cartography. *Exposition, the Bulletin of the University Museum of the University of Pennsylvania*. Philadelphia. 6, 10-13.

Day, A. Grove (1966) *Louis Becke*. New York: Twayne Publishers Inc.

de Brum, Raymond (1962). Marshallese Navigation (as told to C.R.Olson). *Micronesian Reporter* 10 (3), 1-10.

Eisenhart, Otto (1888). Acht Monate unter den Eingeborenen auf Ailu (Marshall-Gruppe). *Aus allen Welttheilen* 19, pp. 207-208, 223-226, 250-252.

Erdland, Augustin (1904). Nachrichten aus der Südsee-Mission. Eine Irrfahrt auf dem Meere. *Hiltruper Monatshefte* 21, pp. 487-491.

Erdland, Augustin (1906). *Wörterbuch und Grammatik der Marshallsprache nebst ethnographischen Erläuterungen und kurzen Sprachübungen*, Archiv zum Studium deutscher Kolonialsprachen, 4, Berlin: Georg Reimer.

Erdland, Augustin (1910). Die Sternkunde bei den Seefahrern der Marshall Inseln. *Anthropos* 5,pp. 16-26

Erdland, Augustin (1912). Die Eingeborenen der Marshall Inseln im Verkehr mit ihren Häuptlingen. *Anthropos* 7, pp. 559-565

Erdland, Augustin (1914a). *Die Marshall Insulaner. Leben und Sitte, Sinn und Religion eines Südsee-volkes*. Anthropos Ethnologische Bibliothek. Bd. 2, Heft 1. Münster i[n] W[estfalen]: Aschendorffsche Verlagsbuchhandlung.

Erdland, Augustin (1914b). Reisenotizen über fünf Atolle der Marschall-Inseln. *Hiltruper Monatshefte* 31, pp. 351-358.

Finsch, Otto (1887). Aus unserem neuesten Schutzgebiet. Kanubau und Kanufahrten der Marshall-Insulaner. *Westermanns Monatshefte* 31, p. 497-498.

Finsch, Otto (1887). Aus unserem neuesten Schutzgebiet. Kanubau und Kanufahrten der Marshall-Insulaner. *Westermanns Monatshefte* 31, pp. 492–504.

Finsch, Otto (1893). Ethnographische Erfahrungen und Belegstücke aus der Südsee. *Annalen des K. & K. Naturhistorischen Hofmuseums* 7. Vienna: K. & K. Naturhistorisches Hofmuseum.

Friedrichsen, I. (1879) *Karte der Marshall Inseln. Auf der Basis der englischen Admiralitätskarte Nº 983 nach den J.Kubary auf Ebon eingezogenen Erkundigungen und nach Angaben des Capitän Mellen*. Hamburg: Friedrichsen & Co.

Giesberts, Leo (1910). Die Seefahrerkunst der Marshallaner. *Hiltruper Monatshefte* 27, pp. 55-60

Gilbert, Thomas (1789). *Voyage from New South Wales to Canton in the year 1788 with views of the islands discovered by Thomas Gilbert Esqu., commander of the Charlotte*. London.

Gulick, Luther H. (1862). The Marshall-Islands. *Nautical Magazine* P.298.

Hager, C. (1886). *Die Marshall Inseln in Erd- und Voelkerkunde, Handel und Mission*. Leipzig: G.Lingke.

Haggett, P.A., Cliff, D & Frey, A. (1977) *Locational Analysis in Human Geography I: Locational Models*. Second edition. London: Edward Arnold.

Hambruch, Paul (1912). *Die Schiffahrt auf den Karolinen- und Marschall-Inseln*. Meereskunde VI. Berlin.

Hasebe, Kotondo (1938) The natives in the South Sea Archipealgo. *Jiuruigaku Senshigaku Koza (Lectures on Anthropology and Prehistory)* 1, pp. 1-35 (cited after Hunt 1950).

Hernsheim, Franz (1887). Die Marshall-Inseln. *Mittheilungen der geographischen Gesellschaft in Hamburg* 1885-1886 (1887), pp. 297-308.

Hernsheim, Franz (1887). Die Marshall–Inseln. *Mittheilungen der geographischen Gesellschaft in Hamburg* 3 (1885–1886), pp. 297–308.

Hezel, Francis X. (1979) *Foreign ships in Micronesia. A compendium of ship contacts with the Caroline and the Marshall Islands 1521-1885*. Trust Territory of the Pacific Islands, Saipan, Northern Mariana Islands.

Hezel, Francis X. (1983) *The first taint of civilisation. A history of the Caroline and Marshall Islands in Pre-Colonial days, 1521-1885*. University of Hawaii Press, Honolulu, Hawaii.

Hunt, Edward E. (1950) A view of somatology and serology in Micronesia. *American Journal of Physical Anthropology* 8(2), pp. 157-184.

Hunt, Terry L. (1988). Graph theoretic network models for Lapita exchange: a trial application. In: P.V.Kirch & T.L.Hunt (eds), *Archaeology of the Lapita Cultural Complex: A critical review*. Thomas Burke Memorial Washington State Museum Research Report 5. Seattle: Burke Museum. Pp. 135-156.

Irwin, Geoff (1985). The emergence of Mailu as a central place in coastal Papuan prehistory. *Terra Australis* 10. Canberra: Department of Prehistory, Research School of Pacific Studies, The Australian National University.

Jenkins, W.S. (1946). Wartime Canoe Building in the Marshall Islands. *American Neptune* 6(1), pp. 71-71.

Kansky, K.J., (1963) Structure of tranportation networks: relationships between network geometry and regional characteristics. *University of Chicago, Department of Geography Research Paper* 84. Chicago: University of Chicago, Department of Geography.

Kotzebue, Otto von (1821) *Entdeckungs-Reise in die Süd-See und nach der Berings-Strasse zur Erforschung einer nordöstlichen Durchfahrt. Unternommen in den Jahren 1815, 1816, 1817 und 1818, auf Kosten Sr. Erlaucht des Herrn Reichs-Kanzlers Grafen Rumanzoff auf dem Schiffe Rurick*. Weimar, Verlegt von den Gebrüdern Hoffmann. 1821. 2 vols.

Knappe, Wilhelm (1886) Verordnung betreffend die Verpflichtung nichtdeutscher Schiffe zur Meldung bei dem Vertreter der Kaiserlichen Regierung in Jaluit. Jaluit 2 June 1886. in: Riebow, Gerd (1898). *Die Deutsche Kolonialgesetzgebung. Sammlung der auf die deutschen Schutzgebiete bezüglichen Gesetze, Verordnungen, Erlasse und internationalen Vereinbarungen, mit Anmerkungen und Sachregister. Erster Theil bis zum Jahr 1892*. Berlin: Dietrich Reimer (1893), pp. 614–615.

Knappe, Wilhelm (1887) Nachtrag zu der Verordnung vom 2. Juni 1886 betreffend die Verpflichtung nichtdeutscher Schiffe zur Meldung bei dem Vertreter der Kaiserlichen Regierung in Jaluit. Jaluit 8 January 1887. in: Riebow, Gerd (1898). *Die Deutsche Kolonialgesetzgebung. Sammlung der auf die deutschen Schutzgebiete bezüglichen Gesetze, Verordnungen, Erlasse und internationalen Vereinbarungen, mit Anmerkungen und Sachregister. Erster Theil bis zum Jahr 1892*. Berlin: Dietrich Reimer (1893), pp. 616.

Knappe, Wilhelm (1887b) Hafenordnung für den Hafen von Jaluit. Jaluit 26 January 1887. in: Riebow, Gerd (1898). *Die Deutsche Kolonialgesetzgebung. Sammlung der auf die deutschen Schutzgebiete bezüglichen Gesetze, Verordnungen, Erlasse und internationalen Vereinbarungen, mit Anmerkungen und Sachregister. Erster Theil bis zum Jahr 1892*. Berlin: Dietrich Reimer (1893), pp. 616-617.

Krämer, Augustin (1905). D*er Haus- und Bootsbau auf den Marschallinseln (Ralik-Ratak-Inseln)*. Archiv für Anthropologie N.F. III Braunschweig: Friedrich Vieweg & Sohn.

Krämer, Augustin (1906). *Hawaii, Ostmikronesien und Samoa*. Stuttgart: Schweizerbartsche Verlagsbuchhandlung.

Krämer, Augustin and Hans Nevermann (1938) *Ralik-Ratak (Marschall Inseln). In: G.Thilenius (ed.), Ergebnisse der Südsee-Expedition 1908-1910. II. Ethnographie, B: Mikronesien*. Vol. 11: Hamburg: Friedrichsen & de Gruyter.

Krulle (1903) Mittheilungen as den Deutschen Schutzgebieten. Bericht über die auf den Mar-

shall-Inseln herrschenden Geschlechts- und Hautkrankheiten. *Arbeiten aus dem Kaiserlichen Gesundheitsamte* 10 (1), pp. 148-154.

Laubenfels, M.W. de (1950a). Ocean currents in the Marshall Islands. *Geographical Review* 40 (2), pp. 254-259.

Laubenfels, M.W. de (1950b). Native navigators. *Research Reviews* (June 1950), Office of Naval Research, pp. 7-12.

Lewis, Dan (1972). *We, the navigators. The ancient art of landfinding in the Pacific. Honolulu*: The University Press of Hawaii.

Merz, Paul (1910) Jahresbericht über die Entwicklung der Marschall Inseln im Jahre 1909/1910. Dated 8 June 1910. Jaluit Journal No. 896/10. Record on file. German Colonial Records from Rabaul, New Britain. Australian Archives, Record Series G2, File N6, Jahresberichte des Inselgebietes. Australian Archives, A.C.T. Regional Repository, Canberra, Australia.

Nakayama, M. & F.L. Ramp (1974). *Micronesian Navigation, island empires and traditional concepts of ownership of the sea.* Joint Committee on the Law of the Sea, Fifth Congress of Micronesia. 14 January 1974. Saipan: Congres of Micronesia.

Pompey, S.L. (1971). *The neglected islands*. Typescripts. (quoted in Nakayama & Ramp 1974).

Prager, Max (1886). *Reisen durch die Inselwelt der Südsee*. Kiel: Carl Janssen.

Prime Ministers Department (1916) *Repatriation expenses of natives of the Marshall Islands*. Commonwealth of Australia, Prime Ministers Department File 201/48. File A 457/1 Australian Archives, A.C.T. Regional Repository, Canberra.

Reichstag (1908) "Denkschrift über die Entwickelung der Schutzgebiete in Afrika und der Südsee im Jahre 1906/07. Teil FII. Deutsch Neu-Guinea, Inselgebiet." *Stenographische Berichte über die Verhandlungen des Reichstages. XII. Legislatur-Periode I. Session. Anlagen zu den Stenographischen Berichten*, Vol. 245 (567-663). Berlin: Julius Sittenfeld. Pp. 4117-4158

Rife 1907 ##

Sander, Ludwig (1906) ***Die deutschen Kolonien in Wort und Bild***. Leipzig : Verlag für Allgemeines Wissen.

Schnee, Paul (1904) Gesundheitsverhältnisse des Schutzgebietes der Marshall inseln in der Zeit vom 1. April 1901 bis 31. März 1902.. *Arbeiten aus dem Kaiserlichen Gesundheitsamte* 21 (1), p. 138

Schnee, Paul (1907). Die europäischen Infektionskrankheiten der Marshall Inseln. *Archiv für Schiffs- und Tropenhygiene* 11, pp. 583-587.

Schück, A. (1902). Die Stabkarten der Marschall-Insulaner. Hamburg: H.O. Persiehl.

Schwabe, Gustav (1896) Berichte über die Gesundheitsverhältnisse auf Jaluit. *Arbeiten aus dem Kaiserlichen Gesundheitsamte* 14, pp. 680-682.

Schwabe, Gustav (1908) Ärztlicher Bericht für die Zeit vom 1 Oktober bis 31. Dezember 1908. Dated Jaluit, 8 January 1908. **In** Acta betreffend gesundheitliche Verhältnisse auf den Marshall Inseln von Oktober 1906 bis December 1912. Auswärtiges Amt, Kolonial Abteilung A^{vi} Medizinalwesen 3h Bd. 4 N° 5787. National Library of Australia, Canberra. Microfilm G 8595.

Seidel, Hans. (1902). Von den Marschall Inseln. *Deutsche Kolonialzeitung* 15, pp. 193-195; 233-237.

Senfft, Arno (1903). Die Marshall Insulaner. In: S.M. Steinmetz (ed.), Rechtsverhältnisse von eingeborenen Völkern in Afrika und Ozeanien. Beantwortung des Fragebogens der Internationalen Vereinigung für vergleichende Rechtswissenschaft und Volkswirtschaftslehre zu Berlin., Berlin: Julius Springer. Pp. 425-455.

Sonnenschein, Max (1888) Verordnung betreffend den Hafen von Jaluit as Einklarierungshafen. 28 June 1888. in: Riebow, Gerd (1898). *Die Deutsche Kolonialgesetzgebung. Sammlung der auf die deutschen Schutzgebiete bezüglichen Gesetze, Verordnungen, Erlasse und internationalen Vereinbarungen, mit Anmerkungen und Sachregister. Erster Theil bis zum Jahr 1892*. Berlin: Dietrich Reimer (1893), pp. 617-618.

Spennemann, Dirk H.R. (1990). *Cultural Resource Management Plan for Majuro Atoll, Republic of the Marshall Islands*. 2 Vols. Report prepared in fulfilment of U. S. Department of Interior, Office of Territorial and International Affairs Technical Assistance Grant MAR-42. Report submitted to the Historic Preservation Office, Majuro, Republic of the Marshall Islands. August 1990. (printed 1992).

Spennemann, Dirk H.R. (1992) Makmõk. Notes on the occurrence, utilisation, and importance of Polynesian Arrowroot (Tacca leontopetaloides) in the Marshall Islands. Republic of the Marshall Islands Ministry of Internal Affairs / Ministry of Social Services Occasional Paper N° 1. Majuro, Marshall Islands: Ministries of Internal Affairs and Social Services.

Spennemann, Dirk H.R. (1996a) Gifts from the waves. A case of marine transport of obsidian to Nadikdik Atoll and the occurrence of other drift material in the Marshall Islands. *Johnstone Centre of Parks, Recreation and Heritage Report* Vol. 23.

Johnstone Centre of Parks, Recreation and Heritage, Charles Sturt University: Albury, NSW

Spennemann, Dirk H.R. (1996b). Dreading the next wave: non-traditional settlement patterns and typhoon threats on contemporary Majuro, Marshall Islands. *Environmental Management* 20(3), 337-348.

Spennemann, Dirk H.R. (1997a) On the origin of drift materials in the Marshall Islands. *Atoll Research Bulletin* 445, pp. 1-8.

Spennemann, Dirk H.R. (1997b) Distribution of rat species on the atolls of the Marshall Islands: Past and present dispersal. *Atoll Research Bulletin* 446, pp. 1-8.

Spennemann, Dirk H.R. (1998) Japanese poaching and the enforcement of German souvereignty in the *Marshall Islands Journal of Pacific History* 38(1), 51-67.

Spennemann, Dirk H.R. (2000) Historic Demographic Information for the Marshall Islands -- Period from 1891 to 1914. Albury: URL: http:/marshall.csu.edu.au/hmtl/demography/1891.html

Spennemann, Dirk H.R. (2003a) The road to urbanisation. Post-dicting the evolution of the road network on Tongatapu, Kingdom of Tonga. in… Jörg Eckert, Ursula Eisenhauer & Andreas Zimmermann (eds), *Archäologische Perspektiven. Analysen und Interpretationen im Wandel. Festschrift für Jens Lüning zum 65. Geburtstag.* Rahden/Westfalen: Verlag Marie Leidorf. Pp.165-178.

Spennemann, Dirk H.R. (2003b). Postlaufzeiten zwischen Mikronesien und Deutschland: Gesuch um Hilfestellung. *Berliner Protokolle* n vol. 62, April 2003, p. 72.

Spennemann, Dirk H.R. (2004) Chamissos Blick auf die Südsee und die Rezeption der "Reise um die Welt" im Südpazifischen Raum. In: *Mit den Augen des Frenden. Adelbert von Chamisso—Dichter, Naturwissenschaffender, Weltreisender.* Berlin : Gesellschaft für interregionalen Kulturaustausch.V. Pp. 142-162

Spennemann, Dirk HR (2005) The Atoll Post of the *Eanijen Rakijen* in 1909. *Berliner Protokolle* Heft 75, Juni 2005

Spennemann, Dirk H.R. (in press) Freshwater Lens, Settlement Patterns, Resource Use and Connectivity in the Marshall Islands. In: Fresh and Salt—Water and Borders. Edited by Stephanie Donald and Heather Goodall. Centre for Trans/forming Cultures. UTS e-press Sydney.

Spennemann, Dirk H.R. (in prep) From Disaster to Disaster…The efforts of the German Colonial Administration in Micronesia to mitigate the effects of the typhoons of 1905 and 1907.

Spennemann, Dirk H.R. and Rapp, Günter (1989) Can rats colonise oceanic islands unaided? An assessment and review of the swimming capabilities of the genus Rattus (Rodentia:Muridae) with particular reference to tropical waters. Zoologische *Abhandlungen des Museums für Tierkunde Dresden* 45(1), 81-91.

Spennemann, Dirk H.R. and Taylor, A. Lavar (2002). German Postal Services to Likiep Atoll, Marshall Islands. *Vorläufer.* 129, p. 3-10

Stuckhardt, Wilhelm (1909) Wilhelm Stuckhardt to Reichskolonialamt. Betrifft japanische Vogelfänger auf der Insel Gaspar Rico. Report dated Jaluit 15 May 1909 **in**: Auswärtiges Amt Kolonial-Abtheilung AIII Acten betreffend Jagd und Wildschutz in Deutsch Guinea. File 7788 Vol 1. January 1892 to February 1913. Jagd und Wildschutz 1e. National Library of Australia, Microfilm MfM G 8613

Terell, John (1977). Human biogeography in the Solomon islands. *Fieldiana Anthropology* 68(1). Chicago: Field Museum of Natural History.

Warren, J. (1860). *The Morning Star: History of the Children's Missionary vessel and of the Marquesan and Micronesian Missions.* Boston: American Tract Society.

Winkler, Captain (1899a). On sea charts formerly used in the Marshall Islands. *Annual Report of the Smithonian Institution.* 1899. Pp. 487-509.

Winkler, Captain (1899b). Über die in früheren Zeiten in den Marschall-Inseln gebrauchten Seekarten. *Marine Rundschau* 1898.

Wright, C.H. (1948). Sailing canoes of the Marshall Islands. *U.S. Naval Institute Proceedings* 74 (550), pp. 1529-1531.

BIOSKETCH: Dirk HR Spennemann is Associate Professor in Cultural Heritage Management at Charles Sturt University, Albury, Australia. His main research interests are German colonial heritage in Oceania, in particular Micronesia, and historic preservation issues in Micronesia in general. His second focus re threats to heritage posed by natural and human hazards and threats posed by managers in their efforts to counter these hazards. Ethical Heritage Planning and Policy are the cornerstones that need to be understood and addressed if our past is to have a meaningful future.

CONTACT: A/Professor Dirk H.R. Spennemann, Charles Sturt University, P.O.Box 789, Albury NSW 2640, Australia e-mail dspennemann@csu.edu.au