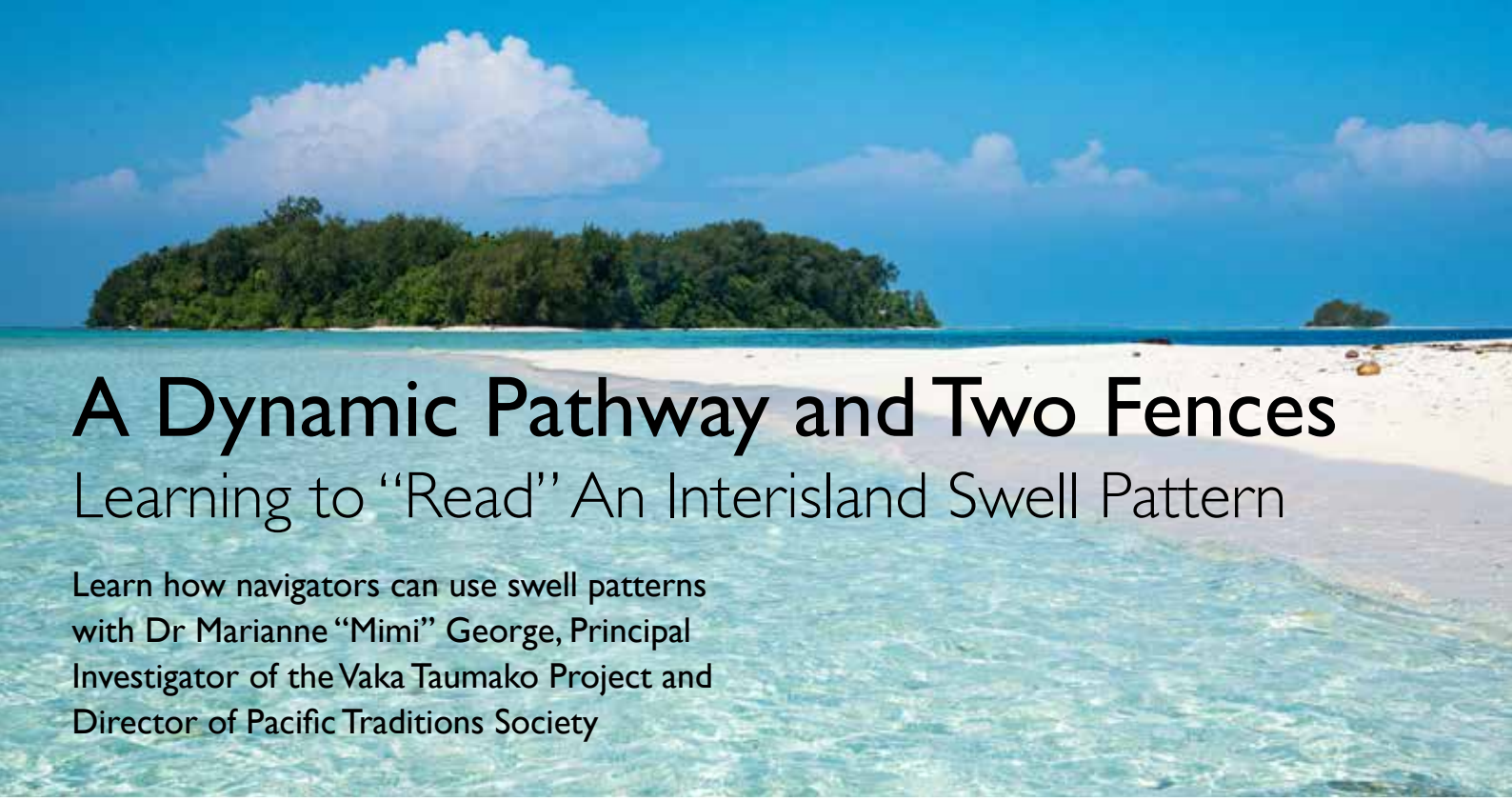

# A Dynamic Pathway and Two Fences

## Learning to "Read" An Interisland Swell Pattern

**Learn how navigators can use swell patterns with Dr Marianne "Mimi" George, Principal Investigator of the Vaka Taumako Project and Director of Pacific Traditions Society**

**Learning to navigate by swell patterns on the ocean has not come easily to mariners of the last few decades. The following presents some static and dynamic descriptions of swell pattern navigation by mariners who received more and less traditional training in various traditions, and a conclusion about how anyone can learn to do it.**

### Learning Swell Trains and Patterns

Mariners know 'swells' as thick, long-period waves that are generated by distant, strong, and persistent winds. Swells travel thousands of miles. We call a succession of swells moving in the same general direction a 'swell train.' By contrast, we know 'waves' as local and relatively short-term phenomena. Waves have peaky shapes and short-periods. Waves are located on the surface of swells.

Navigational experts of the First Peoples of the Pacific taught youth to 'read' swell trains. Temi Rewi of Beru Atoll, Kiribati, sat his daughter down in a "stone canoe" to show her the angle at which to keep her vessel relative to the swell trains when leaving from, and returning to, her island (Lewis, 1972). Expert swell navigators teach their students about the patterns that swell trains form between and around islands, such as the refracting swell lines that can be seen in figure 1.

Various Pacific navigators have drawn diagrams to explain the interference patterns that swell trains form when they refract around the sides of an island, when they crisscross each other in the lee of the island, and/or when swells 'bounce back' or 'reflect' from an island after hitting it (Lewis, 1972).

But there is an experiential gap between diagrams of swell trains and experientially 'knowing' what they represent.

Mariners trained in European celestial navigation methods, and Pacific Islanders who are now trying to learn to 'read' the swell patterns that their ancestors used, struggle to distinguish swell trains or the patterns they make. It is common for people who are untrained in swell navigation to ask "do you see them or feel them?".

Figure 1: A GoogleEarth photo of three tiny islets near Taumako Island.

## Explaining Complex Swell Patterns and Patterned Route Lines

Before heading out to sea, Marshallese students of navigation studied stick and shell models of swell patterns called Matang or Wapepe (see figure 2). Wapepe depict swell train interference patterns around any island or between islands.

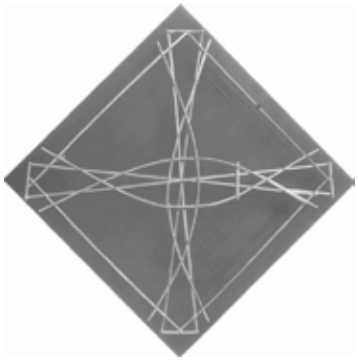

Figure 2. *A photo of Matang as published in Finney (2008). Original photo by permission of Joseph Genz.*

A swell pattern becomes complex when the swell lines of one pattern interact with, or join with, the swell lines of another pattern. This happens when islands are close enough to each other. Many complex swell patterns occur between The Marshall Islands, most of which are only 10 km to 40 km apart, and between some SE Solomon Islands that are over 120 km apart.

In 1898 a German Naval officer, Captain Winkler, reported that traditional Marshallese navigator, Joachim de Brum, labeled the lines on a Matang/Wapepe, and explained how one navigates using these swells. In 2005 - 2006, the late Marshallese mariners Thomas Bokin of Ujae Atoll and Isao Eknilang of Rongolap Atoll, told Joseph Genz their labels for swell lines of Wapepe (Genz, 2018).

According to Winkler and Bokin one of the convex lines in figure 3, below, is called dilep/dileplep (Bokin used the name dileplep rather than dilep), and okhar is the name of the straighter axilary line interior to the lenticular shape formed by two convex lines.

Winkler translated okhar as "root." The "root" line in the overall swell pattern is a line connecting a series of boot ('nodes') that represent the intersection of different swell trains (Winkler in Lewis,1972; Genz, 2018)." Bokin and others described this okhar as a "spinal wave" that is formed by a line of swell intersections, and these are what a navigator can perceive and knows how to orient to.

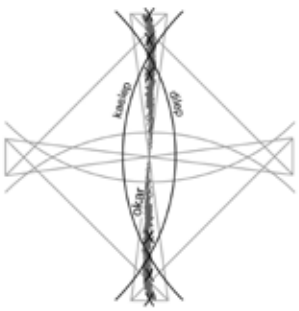

Figure 3. *Wapepe Diagram of Winkler's labels, by permission of Joseph Genz.*

Isao Eknilang had a different terminology. He identified the wavy straighter axilary line as dilep, rather than as okhar. Eknilang also explained that the wavy straighter axilary is an intersection of swells that defines the pathway that is useful to navigators (Genz, 2018).

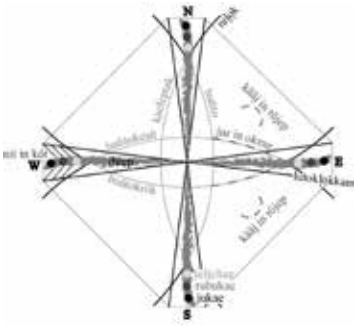

Figure 4. *Wapepe Diagram of Eknilangs labels, by permission of Joseph Genz*

These navigators may have used different names (dilep and ohkar) for the same swell lines because they were taught in different traditions. However what we can understand that all of them agree about is that there is an intersection of swell lines that one can navigate by in the interisland swell pattern of Wapepe. The key question Genz and others have asked is 'which line is the right one?'

## Axilary Versus Border

The late Polynesian Master Navigator TeAliki Kaveia of Taumako, Solomon Islands, explained how such an interisland swell pattern contains both the convex swell line and the internal, or axilary line of nodes that Marshallese navigators call the 'root' or 'spinal wave.'

During the 16 years I partnered with him as he led the Vaka Taumako Project (www.vaka.org), we sailed together throughout the Southeast Solomon Islands. Kaveia instructed me to draw diagrams of the swell patterns he taught. When on shore, Kaveia explained swell patterns on land by drawing diagrams in the sand.

Figure 5. *Te Aliki Kaveia draws the lenticular shape of a swell pattern that forms between Taumako (near his knee), and the nearest of Reef Islands, (near the foot of his student).*

Kaveia distinguished between swells (hokohua loa) and waves (hokohua iti). Kaveia explained that when Easterly and Westerly Hokohua Loa refract around the nearest island, then some of the swells from the Easterly swell train join some of the swells from the Westerly swell train. In this way some of the opposing swell lines intersect with each other and the result is two convex standing swell lines, the combination of which form a lenticular shape between the two islands. Kaveia referred to such standing swells as 'fences', along the inside of which one should sail when navigating from island to island. The 'fence' provides a safe border in that "if you sail over it you feel a big roll." Kaveia's cousin Anna Heilly, of Matema Atoll, added "the fence is a pathway...if you sail alongside it, you will reach the island" (We, the Voyagers: Our Moana: 2020)

Kaveia also explained that a small amount of the energy of the same refracting swells that form the fence, usually moves past the fenceline into the interior of the lenticular shape. So when the residual swell (from those same Easterly and Westerly swells that formed the fence) from opposite sides of the fence pass through to the interior of the fence they intersect and create yet another standing swell pattern. Kaveia represented this axilary intersection of swells as a wavy line, because the exact position of this swell intersection line varies with the strength of the residual Easterly or Westerly swells that are intersecting. If the residual Easterly swell train is stronger than the residual Westerly swell train then the intersection of the two will be located nearer the Western fenceline rather than in the middle between the two fences. Sometimes it even seems to be one with the fence.

Kaveia also expained, the Easterly and Westerly swells that reflect from one of the islands, (one might also call these 'residual swells'), will eventually intersect with residual swells that have reflected from the other island. The nodes of these intersecting reflected swells also form a perceptible line between the two islands.

This interisland swell pattern is strikingly similar to that of Wapepe. Kaveia's explanations of how to navigate between islands using these swell patterns includes both the convex route line that Winkler and Bokin called Ohkar, and the axilary 'boot'/'spinal wave' route line that Eknilang called Dilep. Kaveia's explanations shows how it is not a matter of one or the other being correct...the desired navigational route can be both or either of the wavy axilary line, the outer curved line, or the line that may be formed by reflected swells that are intersecting within and at the fence of the overall swell pattern shape.

Kaveia drew axilary lines in the sand to show how the line bends when the swell from one side of the lenticular shape formed by the two convex Hokohua Loa swell lines is stronger than the swell from the other side. When opposing Hokohua loa are extremely unequal, the line becomes so curved that it parallels, or even joins, the convex fence perimeter.

Kaveia showed that his diagram/model represents a dynamic system. He drew a range of angles at which the opposing swells meet, and the result of formation of both the oval and one or two internal axis lines. Kaveia's model suggests that different positions of dilep in Wapepe fit variances in the articulation of complex swell patterns. The variances express a dynamic reality both inside the "fence" and along its boundary.

What a navigator senses inside the fence is both an abrupt tripping feeling of reflected swells and a rolling feeling of swells intersecting from the sides. But the roll that is felt if a vessel crosses the fence is bigger than any roll one feels inside the fence.

What Kaveia explained is that if a navigator cannot find a line of nodes at the convergence of up to three swell lines–axilary Hokohua Loa, reflected Hokohua Loa, and either or both of the fencelines of combined energy from Hokohua Loa–then the navigator can identify any one of

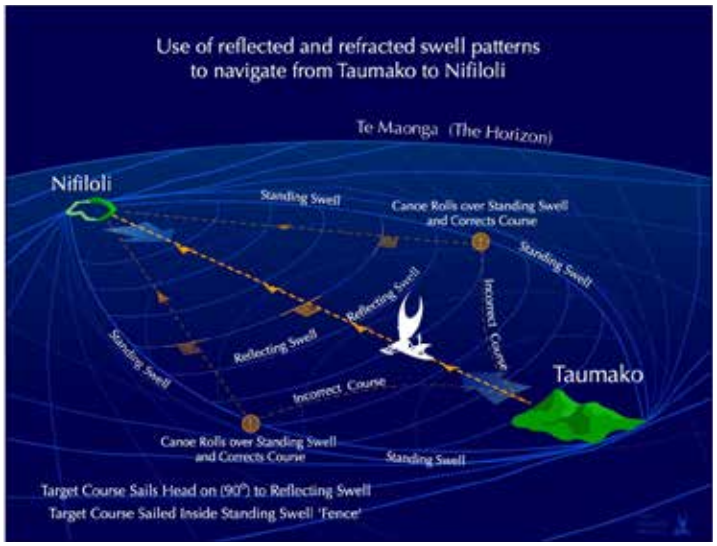


Figure 6. *Graphic art by D. Jackson showing the use of reflected swell patterns to navigate from Taumako to Nifiloli. Copyright Vaka Taumako Project.*

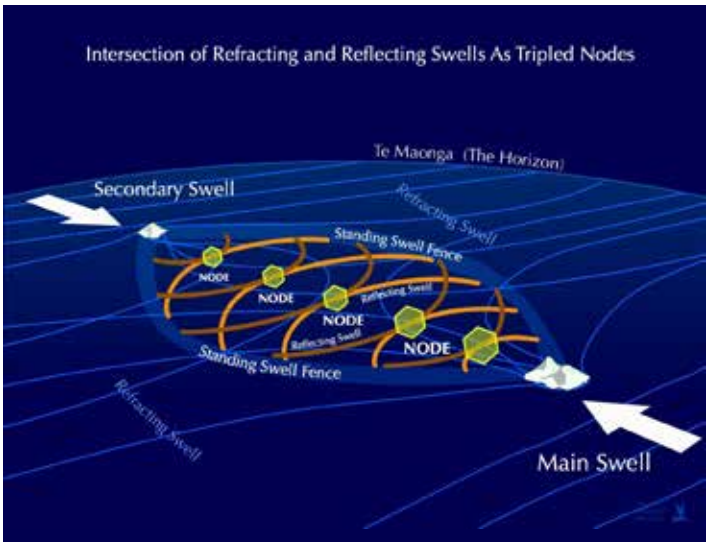


Figure 7. *Graphic art by D. Jackson showing the intersection of refracting and reflecting swells as tripled nodes. Copyright Vaka Taumako Project.*

these three lines of intersecting swell trains, each of which provides independent guidance to the target island. Also, if the navigator wanders over a fence into the outside of the lenticular shape, and does not heed the big roll, then there is a large reduction in the homing signal of reflected swells to tell the navigator she/he is outside the fence.

## Learning to Sense and Use Swell Patterns

The late Rongelap navigator, Lapedpedin, described the balancing motion of opposing swells as the navigator follows dilep to an island and looks for boj (what others have called boot or booj) (Gerald Knight, 1999; Genz, 2008). Eknilang explained dilep as a palpable result of interaction between reflected swells (Genz, 2008). All the navigators Genz interviewed said that they "watch" for the flow of waves (what we call swells in this paper) (Genz, 2008).

Whether seeing or feeling is the sensory method, navigating by swell patterns is a learned skill. How people learn to sense and use swell patterns is a mystery to those who have not taken the time to be trained to see, feel, or use them. Kaveia taught people to see and/or feel the existence all of these swell patterns, and to perceive the balance between opposing swell lines, with the most sensitive instrument possible: their own bodies. 100 years ago, when Kaveia himself was learning to navigate, this was about a 20-year process.

The experiential process for learning all of this takes time. Babies who are cradled in canoes learn how to distinguish and use waves and swells before they walk. Let's keep in mind what Hawaiian voyaging revival leader Nainoa Thompson has said that Satawalese Master Navigator, Pius ("Mau") Piailug told him when he first asked Piailug to teach him how to navigate. Piailug said "I cannot teach you what I know...you are too old. Send me your babies and I will teach them".


Figure 8. *How parts of figures 6 and 7 fit into Kaveia's sand drawing. Photo by M. George. Graphic art by D. Jackson. Copyright Vaka Taumako Project.*

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