**Mia Tegner Project Final Report**
**February 2010, Jessica Carilli**

The project funded through MCBI has formed the basis of ongoing work in the Line Islands, central Pacific. Originally, growth rates coral core samples from Fanning and Palmyra atolls were to be compared to investigate differences in coral health related to differing levels of human population and fishing at these islands. However, the samples from Palmyra, which I was supposed to borrow, were never leant out, so I only was able to calculate growth rates from the Fanning island cores, of which I could only use four (due to the unfortunate angle the cores were drilled, some of them were not useable). However, with additional cores, the growth rate records from these islands will be robust. Cores 5a and 5b were collected from the same coral head and are highly similar (R=0.61), which is encouraging. In October, I will be participating in a multi-investigator expedition to the Line Islands to collect additional coral cores to pursue this question: how fishing has affected coral health in this region.
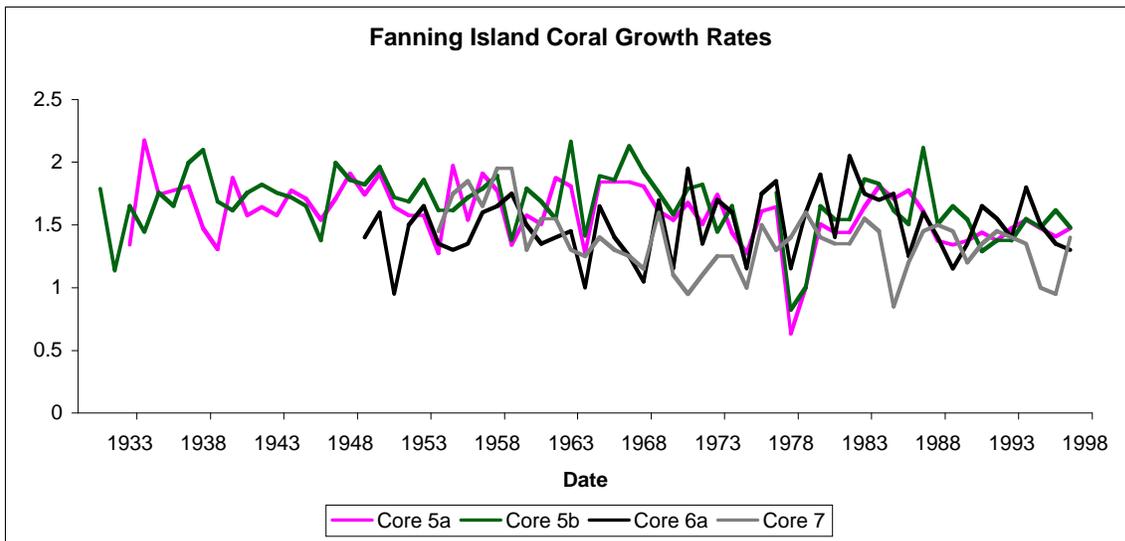
Figure 1: Growth rates from four coral cores collected from Fanning Island (Tabuaeran).

The more successful part of this project was the analysis of benthic foraminiferal assemblages from reef sediments. Scoops of reef sediment were collected from the Line Islands in 2005, fixed in formalin, and stained with Rose Bengal, which dies living tissues pink. I then washed and separated the foraminifera from the rest of the sediment (which consists mostly of pieces of the calcareous algae Halimeda, small pieces of coral and shells, and other biogenic material like sponge spicules and urchin spines). I then separated the foraminifera into pink (living at the time of collection) and white subsets (dead), and then into functional groups—either symbiont-bearing, heterotrophic, or opportunistic taxa. The ratio of these groups to one another changes with water quality—specifically nutrient levels. As nutrients increase, heterotrophic and opportunistic taxa become more common, and symbiont-bearing foraminifera become less common. Hallock et al. (2003) developed a system to assign an index value to this ratio (called the FORAM index), with values from 1 (100% opportunistic) to 10 (100% symbiont-bearing), with higher numbers indicating better

water quality. Values less than 4 are considered to reflect water quality that is marginal for coral reef growth. Although the dead foraminifera samples are most likely comprised of a mix of ages, we estimate that the average age is ~50 years. Fanning and Kiritimati were settled in the past few decades, while Palmyra was used as a military base during WWII and now only has a population of about 10 research staff. Kingman is uninhabited.

FORAM Index Values for the Line Islands
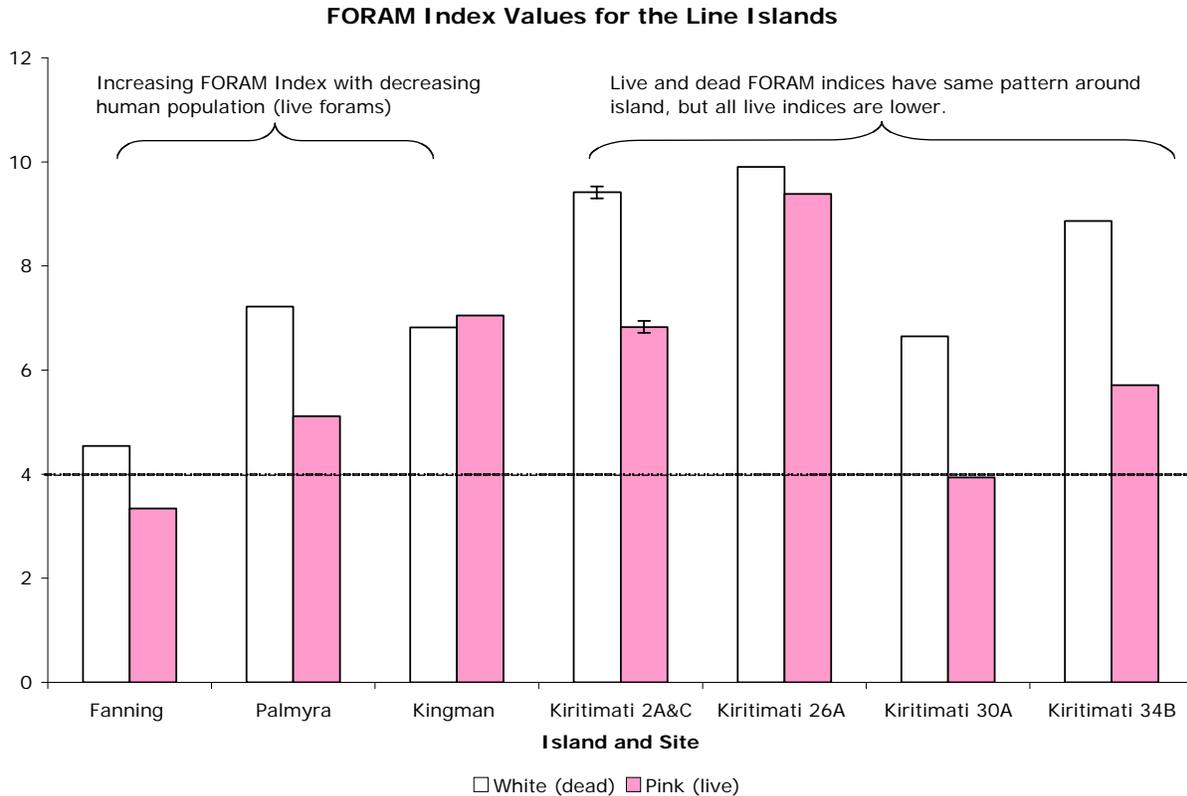
Figure 2: FORAM index values calculated from living (pink) and dead (white) benthic foraminifera from different sites in the Line Islands. White forams are assumed to represent pre-human conditions.

The data so far indicate that between Fanning, Palmyra, and Kingman (in order of decreasing human population, from about 2500 to 0), the living FORAM index increases. This indicates, as expected, that with more people, water quality declines. This is contrasted with the pattern in the dead foraminifera, which show us that even before human settlement, there were higher nutrients at the Fanning Island site than at Palmyra and Kingman. This could be due to upwelling or lagoonal influence, and will be investigated further when I analyze additional samples from each of those islands. The story at Kiritimati (human population ~5000) is also interesting—all sites show a decrease in FORAM index from pre- to post-human settlement, while site 30, which is the closest to the main population center (London town), has the lowest FORAM index both in the live and dead indices. The Kiritimati samples were collected last year in collaboration with several other researchers who were focused on how differing amounts of fishing and lagoonal influence and island wake upwelling (which supply nutrients) affect reefs around the island. It will be particularly interesting to compare these samples, which give an idea of both the historical and current water quality, to these other datasets that include fish and benthic cover surveys.