

MAPPING THE PREHISTORIC STATUE ROADS ON RAPA NUI USING REMOTE SENSING SATELLITE IMAGERY

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ABSTRACT

In an extension of the work of Drs. Hunt and Lipo published in *Antiquity* (2005), I surveyed the prehistoric roads of Rapa Nui (Easter Island) using ArcGIS software and satellite images of the island. A pre-determined set of criteria was utilized, though there was much potential for error with both false positives and negatives. A great deal of progress was made in identifying potential locations of prehistoric roads. This survey only provided possible sites, however, which will require confirmation through ground survey in future visits to the island.

INTRODUCTION

This project served as a continuation of the work of Dr. Carl Lipo of California State University Long Beach and Dr. Terry Hunt of the University of Hawai'i-Manoa in mapping the prehistoric statue roads of Rapa Nui (Easter Island). As published in *Antiquity*, their article presented “an extensive analysis of the island’s roads as a complement to the intensive studies undertaken by” Dr. Charlie Love (Lipo and Hunt 2005). Dr. Love has recently researched the composite features of the ancient roads, including cross-sectional excavations (Love 2000). The documentation of the roads is an essential element in the current debate surrounding models for movement of the monolithic stone statues of Rapa Nui (Lipo and Hunt 2005). Using satellite imagery analysis and an established set of criteria, the island was surveyed for potential road features which will require further ground-truthing for confirmation. I was able to expand the catalog of prospective ancient roads beyond that established by Lipo and Hunt.

METHODS

The satellite images consist of three panchromatic images acquired by the QuickBird satellite in December 2001 and February 2002. The images account for 92% of the island’s surface at a resolution pixel size of 70 cm. Taking into account the inability to read the ground topography in the modern town of Hanga Roa or beneath tree canopies and cloud cover, approximately 85% of the island is left available for examination. Extensive agricultural practices in the central part of the island also made survey of roads difficult in those areas. The images were useful due to the fact that their resolution is “an order of magnitude greater than the width of the road features” (Lipo and Hunt 2005).

The establishment of criteria for this search started with consultation with Drs. Hunt and concerning the original survey methods for the preliminary roads search. Potential road features can be recognized as linear forms on several criteria, often found in combinations, including vegetation differences, depressions filled with cobble scree, banks, trails between statues, erosion patterns and shadow marks. These features tend to display themselves as chromatic variations in the satellite images (Figure 1). Following patterns of statues across the island with an overlay

layer showing *moai* (statue) locations proved very useful in furthering the roads survey. The *moai* can be seen to create a somewhat linear configuration across the landscape. The location of these statues away from *ahu* (ceremonial platforms), indicates they were left en route, and never completed their journeys, thus lying along the ancient roadways.

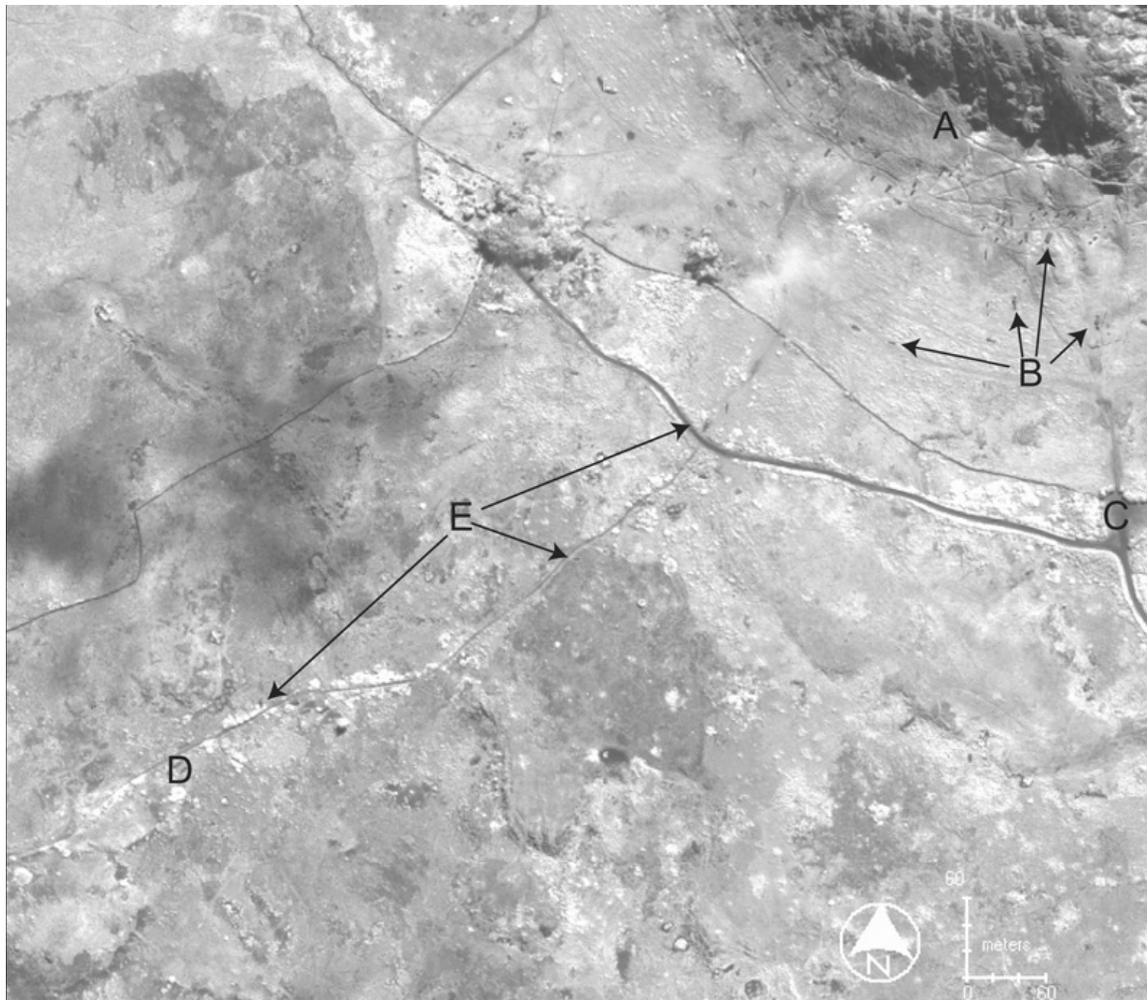


Figure 1. A panchromatic 70cm resolution QuickBird satellite image showing an ancient road section leading west-south-west from the Rano Raraku statue quarry (A). Statues that surround the quarry are easily visible in this image (B) with modern tourist trails among them, as is the modern parking lot and modern road (C). The ancient road (D) is visible primarily as a horse trail and as a line of vegetation that runs from the north-east to the south-west corner of the image. This feature likely reflects sediment compaction with greater water retention and subsequent vegetation growth. Multiple large statues (*moai*) line this road near the quarry (E). The satellite image was provided by RADARSAT, Inc and DigitalGlobe, Inc (Lipo and Hunt, 2005).

Primarily I had to accustom my eye to recognizing such features on the images. Beginning with a blank slate, I retraced the roads shown by Hunt and Lipo (2005) (Figure 2). The original paper confirmed 32 km of roads on the island (Figure 2). After following and extending these features, I sought to track linear features branching out from the primary *moai*

quarry at Rano Raraku crater. A systematic survey by transects across the island revealed more sites for confirmation that could not be seen in relation to the central quarry.

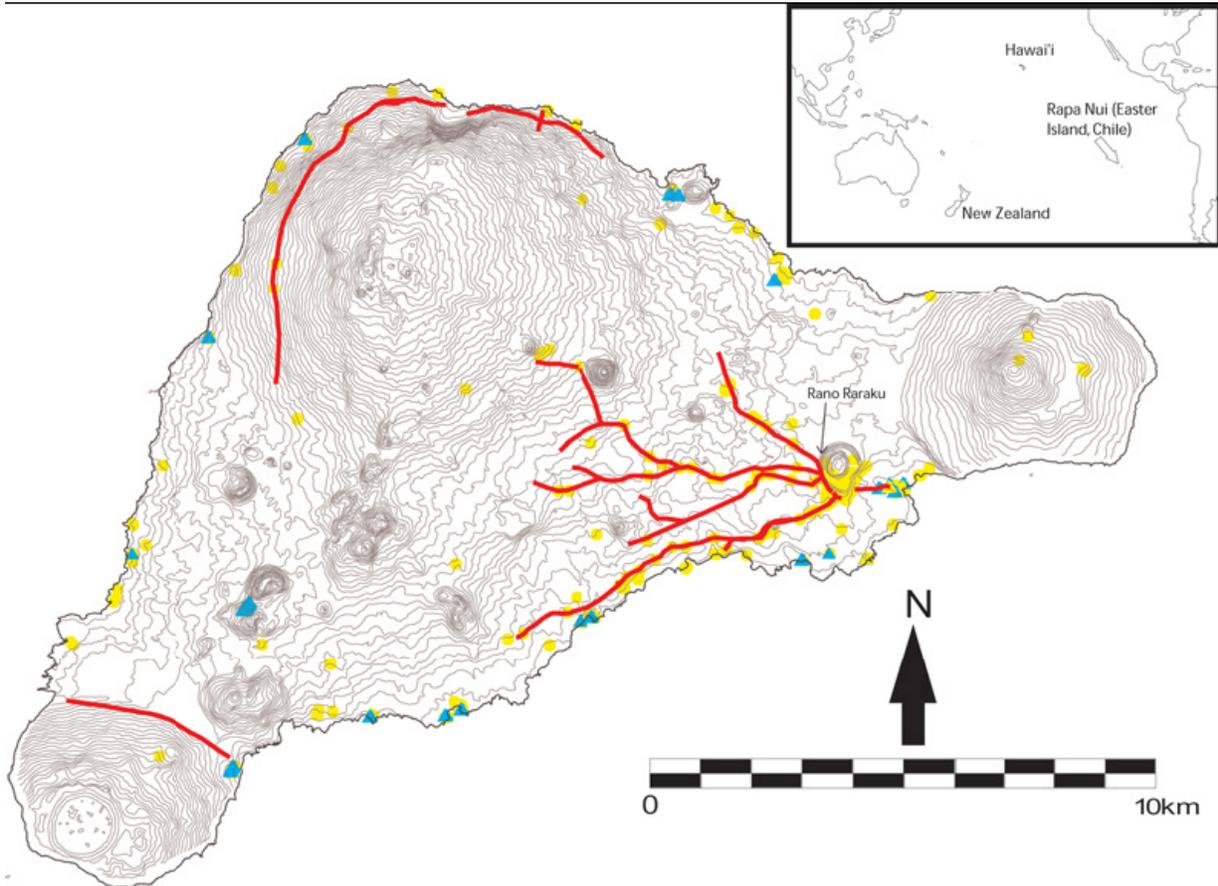


Figure 2. An island-wide distribution of 702 statues (moai, yellow circles), 87 topknots (pukao, blue triangles) and confirmed ancient statue roads (red lines) made on a mosaic of satellite images. About 32 km of roads are shown. The north-north-west road extends 2.7 km; the west-north-west road, 4.5 km, with a western branch an additional 2.6 km; the west-south-west road (discontinuous) 4.0 km; the main southernmost road 8.6 km; Rano Kao Crater road 3.6 km; and the west-north coast road, 13.0 km. A possible road leads directly north from the quarry at Rano Raraku (4.4 km), but additional field evaluation is necessary to confirm an ancient road given historic and modern activities on the same route (Lipo and Hunt, 2005).

Difficulties in the survey included both false positives of other linear features besides roads, and false negatives where roads were obscured or confused for modern objects. Historic and modern roads as well as stone walls appear clearly as linear objects on the image, but can usually be eliminated as possible roads. However livestock trails and dry streambeds and erosion channels (there are no permanent streams on Rapa Nui) present similar chromatic signatures to known road features. Overlap occurs in many areas where modern roads and hiking or livestock trails follow prehistoric pathways. When development first began on the island, the easiest routes for travel were along the previously established prehistoric roads. With the inconsistent, rocky landscape of the island, the easiest paths for jeeps and horses were those

cleared for statue movement. It is difficult to distinguish places where this occurs. Roads are also undetectable in developed areas. This difficulty primarily occurs in the southwestern region of the island, where the population is concentrated in the lone city of Hanga Roa and surrounding farmland.

Following the initial survey, I compared the satellite image to historic surveys and existing field school data. A map created by French explorers in 1877 shows several paths and roads on a distorted image of the island. Despite a measure of distortion, this map is useful in that it illustrates road patterns before ranches obscured large portions of the island and livestock ran trails across the landscape. A second map by the Heyerdahl expedition of 1955-56 shows several known prehistoric roads as well as jeep roads on the island. This survey represents the island before most of the modern roads were built, and offers some clue as to the historic and modern use of prehistoric roadways. However at this time the issue of overlap presented itself with the need to acknowledge that historic and modern trails likely followed ancient roads. Lastly, I used coordinates collected by past University of Hawai'i field schools on Rapa Nui to distinguish features which have been investigated and deemed to represent prehistoric statue roads.

RESULTS AND DISCUSSION

I was able to extend potential sites for future confirmation beyond the survey of Hunt and Lipo. This is evidenced in the extension of the road along the south coast running parallel to a modern paved road. The eastern portion of the island to the northeast of Rano Raraku crater and around the Poike peninsula also contained several possible roads (Figure 3). Unfortunately, this area is one of the least open to survey due to private ownership and uncertain terrain.

Documentation of the ancient roads of Rapa Nui allows for the evaluation of competing models for how the statues were moved, one of the great mysteries of Rapa Nui. A record of the roads provides the minimal distances that the statues could be transported (Van Tilburg 1994). Mapping the paths can also provide clues for the social, economic and political organization of the ancient islanders. The roads emerge from the quarry in a radial pattern, suggesting that they were not necessarily shared, but each region (potentially related to individual social groups) had its own road for delivery of statues from Rano Raraku. This apparent independence and lack of cooperation indicates the lack of a centralized authority. A model of smaller, competing groups is more likely.

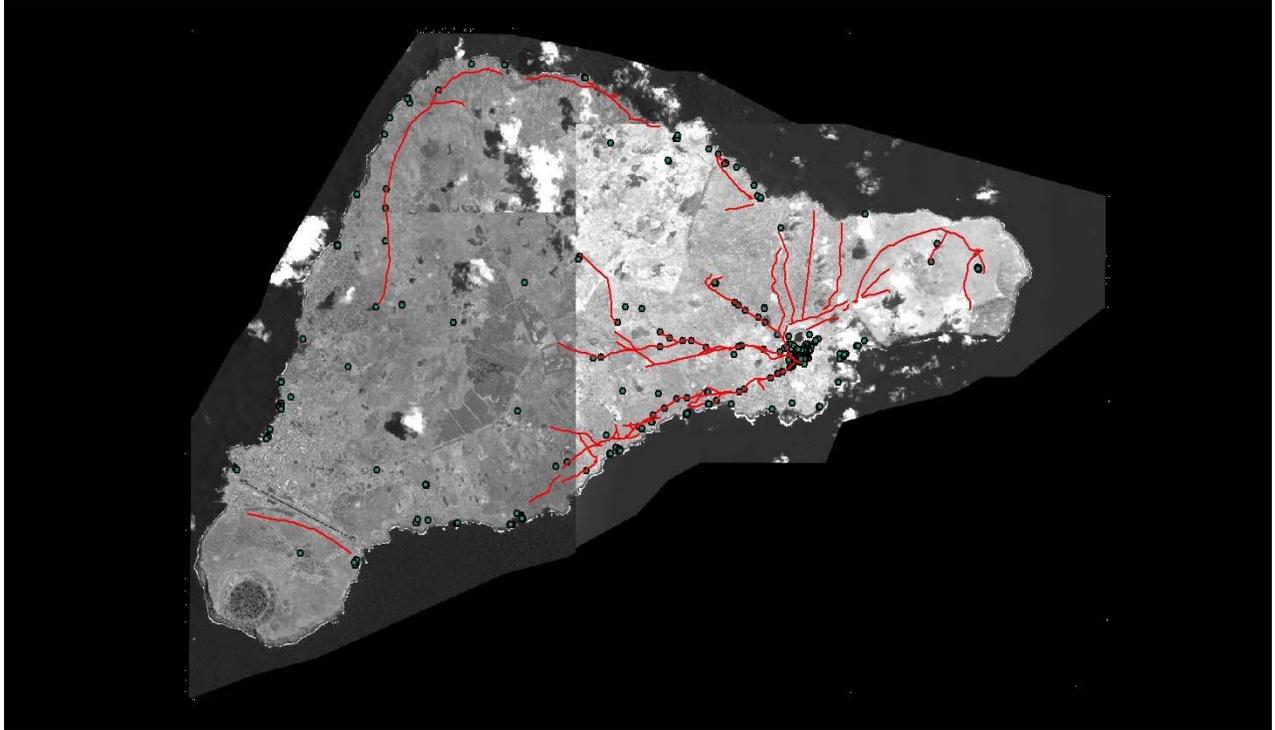


Figure 3. The south coast road and eastern portion of the island exhibit the most development following my survey. These sites would be the most beneficial to survey for confirmation by later field schools.

ACKNOWLEDGEMENTS

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