

LOAN COPY ONLY

PROCEEDINGS OF THE
THIRD ANNUAL STUDENT SYMPOSIUM
ON MARINE AFFAIRS

Sea Grant Miscellaneous Report
UNIHI-SEAGRANT-MR-78-03

January 1978



This proceedings of the Third Annual Student Symposium on Marine Affairs, which will be held at the University of Hawaii Manoa campus on January 13, 1978, is published with funds provided by the University of Hawaii Sea Grant College Program under Grant No. 04-7-158-44129. The US Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notations that may appear hereon.

TSUNAMIS IN THE HAWAIIAN ISLANDS
by Keith Kanetani, Hilo High School

ABSTRACT

Since Hawaii is affected constantly with tsunamis generated locally and from places around the Pacific, averaging one every seven years, it is only fitting to make others aware about the causes, locations and the damages done by the past tsunamis. In the past thirty years six major tsunamis smashed into the islands causing severe damages amounting to millions of dollars. This paper will give some detail facts about the past tsunamis.

INTRODUCTION

Hawaii has been affected with tsunamis dating back to 1813. Since then, many tsunamis have been recorded, but some of them were so small that they hit the islands unnoticed. During the 19th century, numerous tsunamis were reported in newspapers and other news medias, but news traveled slowly in those days and as a result, causes, effects and dates were often scrambled. For instance, if there was an earthquake in Chile, it would take months before it would be known in Hawaii. Toward the end of the 19th century, seismological stations became available and the establishment of the Volcano Observatory in 1912 brought a number of scientists to the islands, who began to make studies on earthquakes and tsunamis. The observatory was established by Dr. T.A. Jaggar, a noted volcanologist. The April 1, 1946 tsunami which originated from the Aleutians, killed 600 people in Hawaii crystallizing the need for a reliable tsunami warning system. In 1948 the Tsunami Warning System was established and has provided warnings of on coming tsunamis. Locally generated tsunamis with localized effects occurred in 1869, 1872, 1878, 1903, 1908, 1919, 1921 and 1924. Most of the tsunamis were triggered by volcanic activity and associated earthquakes of Kilauea and Mauna Loa.

METHODOLOGY

To study the past tsunamis and the devastating effects that it brought to the Hawaiian islands. This paper has been compiled from historical accounts, newspaper archives, charts and other reports. The study points out some of the more destructive waves that hit the islands in the past 163 years.

LOCATION OF THE HAWAIIAN ISLAND

The Hawaiian islands are located in the north central position of the pacific ocean and lies about 2, 300 miles south-

east of the United States. The main Hawaiian group of islands consists of: Niihau, Kauai, Oahu, Molokai, Lanai, Kahoolawe, Maui, and Hawaii together with adjacent islets which stretches over a distance of nearly two thousand miles. All the major islands are inhabited except for Kahoolawe. Long ago two other islands were in the chain, those were Nihoa and Necker, they were inhabited by Polynesians, but now these islands are uninhabited.

TSUNAMIS IN GENERAL

Tsunamis are not always gigantic, it's only when the waves are approaching the shore that it turns into destructive monsters. The average height of a tsunami in the open sea is only about 2-3 feet. During the 1946 tsunami at Hawaii, the crew of a freighter parked about a mile off shore watched the waves break over the buildings, but as far as they could tell there was nothing going by them. Test on tsunamis confirms that the surge velocity is determined by the oceans topography. Tsunamis maintain their strength for such great distances. The great Krakatoa volcanic explosion in 1883 produced tsunami waves that traveled two or three times around the globe.

In order for a tsunami watch to be instituted, the earthquake magnitude has to be equal or greater than 7.0 on the Richter scale. No one can really predict a tsunami or say that there's a typical tsunami. Every tsunami is different, but there are some common factors. One example is that tsunamis are a series of waves, you can get some idea why a tsunami is a series of waves by recalling what happens when you drop a pebble into a pond of water. It produces widening circles, and a tsunami is the same thing, only on a colossal scale.

TSUNAMI DETECTOR

Scientists in the state of Hawaii are developing a new device that will alert people about approaching tsunamis. This deep water sensor will be able to detect tsunamis that are approaching. This sensor will also probe for seismic mechanisms that causes

these tsunamis. This device that is being experimented on, will be placed of the ocean bottom, far away from the shore itself. Deep water sensors on the ocean floor around the Hawaiian islands should enable scientist to predict more accurately what will happen and what the amplitude will be before it actually strikes. A gauge will be connected to the shore via satellite or with a cable that will run along the ocean bottom. The estimated cost of this complex deep-water detector will run up to about \$80,000 to \$90,000, and should be completed in about a year. Cooperative ventures with the Russians will take place next fall. The instrument will be placed in a seismically active place on the bottom of the ocean floor.

Other reasearch is also being done to determine the effects on various Hawaiian coastlines from tsunamis from different parts of the ocean. Other equipment is also being devised to trigger a warning to Hawaiian areas from locally generated earthquakes.

What they hope to accomplish by doing this is to make something that will refine the warning system and reduce false alerts. They don't want to warn people needlessly, otherwise the people may become complacent and ignore the warnings as happened in Hilo prior to the 1960 tsunami in which 61 individuals perished.

DAMAGES DUE TO TSUNAMIS

Devastating effects have been experienced in Hawaii due to two major tsunamis within the past twenty years, namely the 1946 Aleutian tsunami and the 1960 Chilean one, which wiped out the town of Hilo.

There are three types of damages that are produced by tsunamis. These are:

- 1) Tsunami inundation as a rapid high tide. Usually houses are swept completely off their foundation and vessels would be carried inland and grounded.
- 2) A combination of 1 and 3. Here, the major effect would be flooding as a tidal inundation, however backflow may occur and erosion and local impact damage such as caused by 3 may occur.

3) Severe tsunami damage due to very high water velocities everywhere. Buildings and houses are completely destroyed, land and vegetation is stripped and eroded and rock, coral and other debris are left scattered. The third type is the most destructive and this was the case in the 1960 Chilean tsunami that struck Hilo.

Usually it is not the first wave that causes the damages, but the later waves. Such a thing happened in the May 22, 1960 tsunami that struck Hilo. At 6:47 pm the U.S. Coast and Geodetic Survey Magnetic Observatory issued a seismic sea wave warning and estimated it to reach Hilo at about midnight. At 8:30 pm the sirens were sounded, warning the people to evacuate low-lying areas for higher grounds. At 12:13 am the first wave struck at four-plus feet and at 12:46 am the second wave crested at about nine-plus feet and a turbulent, retreat from the Wailoa estuary into the bay began. The second wave topped the Hilo breakwater sea-wall and flooded an area near the center of the business district. The water continued to pour out of the estuary until 1:00 am, when measurements were taken, the tape showed that the level was seven feet below the pre-water level. By 1:02 am, a distant rumble could be heard and as peoples eyes searched the darkness for the source, all that could be seen was a pale wall of tumbling water. The crest of the third and the largest wave could be seen with the dim lights that were shining from the town of Hilo. The wave seemed to grow as if moved steadily towards the shore. At 1:04 am the 35 feet high nearly vertical front smashed into the town of Hilo. All that could be seen was blue-white flashes which showed the location of the tsunami front. At 1:05 am, the wave reached the power plant and after a brief greenish electrical arch, Hawaii was plunged into complete darkness. By 2:15 am, the height of the waves had deminished sufficiently and it appeared safe to enter the devastated streets. This experience was described by three trained observers: J.P. Eaton, D.H. Richter and W.U. Ault.

CONCLUSION

In general, the most destructive tsunami that inundated the Hawaiian Islands was the April 1, 1946 one. This tsunami was the most destructive on the records for the state of Hawaii. Water elevation rose as high as 50 feet and inundated up to half a mile. The tsunami that hit the islands in May 22, 1960, which originated in Chile was also severe, however, it's effects were felt mainly along the southern shores of the islands. The run-up of both of these tsunamis were recorded around coastlines of the major islands.

The inundation caused by a tsunami can be determined by the following:

- 1) The wave elevations at the different coastlines (or other datum seaward of the coastlines)
- 2) The character of the waves. (whether it is a bore or a non-bore surge)
- 3) The beds profile and the roughness of the oceans topography over which the waves travels.

Due to the paucity of tsunami records along the coastlines of the islands until recent times, no one is able to make long-term statistical predictions. It is found that Honolulu, Kahului and Hilo have sufficiently long records such that these predictions can be made.

REFERENCES

- Wybro, Pieter, 1976. "The Determination Of Tsunamis And Forces For the State Of Hawaii" University of Hawaii, James K. Look Laboratory Of Oceanographic Engineering, Department of Ocean Engineering. Technical report no. 40.
- Carayannis, George, 1969. "Catalog of Tsunamis in The Hawaiian Islands" U.S. Dept. of Commerce Environmental Science Services Administration Coast & Geodetic Survey.
- Loomis, Harold, 1976. "Tsunami Wave Runup Heights In Hawaii" Hawaii Institute of Geophysics University of Hawaii, Honolulu.
- Weigle, Edwin, 1974. "Tsunamis" National Oceanic and Atmospheric Administration, Volume 4 Number 1.