

FULL CIRCLE: RETURNING THE POWER OF ORAL HISTORY
TO THE COMMUNITY OF BIG LAGOON, CALIFORNIA
THROUGH TSUNAMI EDUCATION AND PLANNING

By

Kathleen Sullivan Fairchild

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Committee Membership

Dr. Marlon Sherman, Committee Chair

Dr. J. Mark Baker, Committee Member

Dr. Yvonne Everett, Committee Member

Dr. J. Mark Baker, Graduate Coordinator

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ABSTRACT

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In the last decade, we have become very aware of tsunamis and the danger they pose for coastal communities. My research revealed a rich oral history of tsunamis from the Yurok, Chetco and Tolowa tribes who still reside along the northwest coasts of California and Oregon. Geologic evidence of the area further supports these tsunami stories. The oral history of tsunamis was an important tool of survival education within these tribes. Inspired by the Native American stories and the recent tsunami disasters, my project focused on creating an education campaign in tsunami awareness, planning and hazard reduction in the community of Big Lagoon. In association with the Redwood Coast Tsunami Work Group (RCTWG), I initiated contact with members and agencies in the Big Lagoon community including Big Lagoon Rancheria, Big Lagoon School, Big Lagoon Park Company and Big Lagoon County Park to begin the process of public education, mapping out and testing the best evacuation routes for each area, installing warning signage and holding community evacuation drills.

During all phases of the project, I employed avenues of modern story-telling, including pamphlets, articles in newspapers, and internet and television coverage to get

the word out to the local community and the community at large. Due to these grassroots efforts, the community of Big Lagoon now has a greater awareness of tsunami, knowledge of safe locations and routes to reach them and consistent evacuation route signage. Through the process of the TsunamiReady program (a trademark of the National Weather Service) the Big Lagoon community was declared a TsunamiReady community by the Eureka, California branch of the National Weather Service on March 26, 2010.

DEDICATION

This work is dedicated to both of my parents, to my mother Patricia Foster Sullivan, who's endless encouragement to pursue higher education has kept me going all these years, and to my father, James Sullivan who continually reminds me to "keep the faith" in myself.

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INTRODUCTION

In this project report I will discuss my efforts in education and planning to help make the small communities of Big Lagoon and Big Lagoon Rancheria TsunamiReady. This project began as a study of Big Lagoon, California as an ecosystem. Ecosystems not only include the natural world, but also the world of human interactions within the ecosystem. One of these human interactions is the tradition of oral history, which informs us today of past events that were of great significance such as the occurrence of tsunami. This was important information to be passed on as a survival tool by early Native Americans. It was apparent that several areas of the community, including the Big Lagoon Rancheria, are located close to sea level and therefore were within the tsunami inundation hazard zone. There were no tsunami modeling maps of the area at this time. As I was familiar with many aspects of the community, I knew that the school children visited the seaside on a weekly basis as part of "Science Fridays". I also knew that there were no tsunami evacuation drills being practiced by the school. In association with the Redwood Coast Tsunami Work Group (RCTWG), we began walking possible evacuation routes and leading drills with the school and the community.

My literature review reflects the diversity of disciplines and concerns related to my project, from geology and earthquake science, to Native American oral history, social science and disaster planning. All of these topics are important to understanding the significance of local tsunami planning. I present an overview of the Big Lagoon community in terms of ecosystem, history and the various entities and agencies located in Big Lagoon. I then describe the process of helping to make Big Lagoon TsunamiReady.

LITERATURE REVIEW

Disaster Planning

To set the stage for this project, I will first present the significance of the tsunami hazard worldwide. Hazard events such as tsunamis, that become disasters, are an increasing global concern. A disaster is an emergency of a magnitude that overwhelms existing local resources (Novick, 2005). Whether a natural event, such as an earthquake, tsunami or hurricane, becomes a disaster depends upon several factors. These factors include the geographic location in relation to population, and the social vulnerability of that population in terms of preparedness, response and reconstruction (Smith, 2006). On average, there is one disaster per week that requires external international assistance somewhere in the world. Recent events, most notably the Indian Ocean Tsunami of December 26, 2004, and the Japan Tohoku Tsunami of March 11, 2011, have emphasized mankind's vulnerability to these events and the necessity for preparedness (Risk Management Solutions Inc., 2012).

The toll of human casualties from the 2004 Indian Ocean Tsunami has no modern historic equal. The death toll of more than 200,000, combined with roughly 1.5 million displaced by the tsunami, stunned the world. Most of the loss of life occurred in Sumatra, Indonesia, where virtually every village, town, road and bridge built below 33 ft. elevation along a 106 mile stretch of the western coast of Aceh Province was destroyed. It is estimated that on average 50% of the people living in that coastal region died (Risk Management Solutions, Inc., 2012). This tsunami was so immense it circumnavigated the

globe, primarily affecting the population of the Indian Ocean, causing more deaths and property damage in Thailand, India, Sri Lanka, Myanmar, the Maldives, the Seychelles Islands and the coast of Africa (NOVA, 2005).

The 2011 Japan Tohoku Tsunami took even the well prepared Japanese people by surprise (Reuters, 2011). The tsunami killed more than 19,000 people and in its aftermath devastated the Japanese landscape, economy and the cultural morale of its citizens. The earthquake, tsunami and resultant nuclear disaster has left the Japanese people suffering and questioning their government (Earthquake-Report, 2012). Children have been especially affected by the loss of loved ones and their homes. It is predicted by epidemiological psychiatrists that post-traumatic stress disorder (PTSD) will become an even bigger public health problem in Japan as these children age, as there are very few professionals trained in this field in Japan (ABC News, 2012). Not all tsunami are on the scale of a disaster, some tsunami cause only minor tidal changes within harbors. Tsunami disasters are traumatic events that are experienced by thousands of people, with wide-ranging physical and mental health consequences. The most common debilitating disorder that occurs after disasters is PTSD. Research in the field of population health suggests a pressing need to identify key areas of consensus within post-disaster management to comprehensively and systematically assess the epidemiologic evidence about PTSD after disasters (Galea, Nandi, Vlahov, 2004). The role of public health in disasters is certainly not new, but it is now being recognized and emphasized in the wake of these recent earthquakes and tsunamis. Throughout history, public health activities have been undertaken because of the need for collective action to counter hazards:

controlling transmissible disease, removing environmental threats, and providing safe drinking water and a safe food supply (Enrico Quarantelli Collection, 2004). In the past, only the needs of the physical body were addressed in disaster aftermath planning. Today, reconnaissance teams returning from these tsunami destruction zones are emphasizing the acute need for mental health assistance (Dengler, 2011, personal communication).

Researchers in the field of disaster management are also proposing a paradigm shift to reflect a focus on the concept of vulnerability to hazards, because we have control over our vulnerability to the hazards, but not the natural hazard itself (McEntire, 2004). In other words, one can choose not to live in a tsunami hazard zone. This option, however, is not available to all, particularly the poor. As was witnessed during hurricane Katrina and its aftermath, topographic gradients doubled as class and race gradients. Those who were better off financially, were more able to easily evacuate, as they were more likely to own cars, have credit cards and bank accounts for emergency provisions or hotels, and had insurance policies to rebuild afterwards (Smith, 2006). Socially created vulnerabilities have largely been ignored in the hazards and disaster literature because they are not readily quantifiable (Cutter, 2006). Social scientists hope that through documenting the differential and changing patterns of risk and vulnerability, long term levels of injustice will be exposed and can begin to be addressed (McEntire, 2004).

As stated in *Planning for Risk: Comprehensive Planning for Tsunami Hazard Areas*, (Peterson, 1998), risk assessment develops a clear understanding of the physical parameters on end effects of the tsunami by defining the exposure characteristics of the

community. It is necessary to identify local officials' response capability, so that policies, practices, and strategies promote effectiveness (Folz & French, 2005). Especially in rural areas, individual community members will be the first responders. State and Federal agencies show up well after a disaster, if at all (Dengler, 2006, personal communication).

Planning for the hazard of tsunami first requires awareness and education. The hazard exists, but the risk, i.e. the exposure to the hazard, can be mitigated. This process can partly be accomplished through education to identify the risks and therefore the threat to a specific area. The next step is to then devise ways to reduce that threat (Hebenstreit, 1997). So, community disaster planning begins with awareness of the hazard, in this case the hazard of tsunami. This starts with knowing the four natural warning signs of an impending tsunami:

- 1.) Experiencing any earthquake while on the beach or an earthquake lasting more than 20 seconds within a tsunami hazard zone.
- 2.) Seeing the ocean recede prior to an approaching tsunami. There may be a sudden change in sea level.
- 3.) Noticing a "strange change" in ocean activity.
- 4.) Hearing a rumbling sound as the tsunami approaches.

A local tsunami is generated by a perceptible earthquake near shore with significant ground shaking. A distant tsunami is caused from a distant source earthquake or underwater landslide and there is no perceivable warning. The warning for distant source tsunami, which may take hours to arrive, is coordinated via the Tsunami Warning System (TWS). The TWS is an international effort to save lives. It is comprised of 26 international Member States. The TWS has the functions of monitoring seismological and tidal stations throughout the Pacific Basin to evaluate potentially tsunamigenic

earthquakes and disseminating tsunami warning information to warn people through sirens and NOAA weather radios (Tsunami Warning System, 2008). The Indian Ocean Tsunami Warning System is also now functioning (NOAA, 2012). In recent experience, social media has played a role in dissemination of tsunami warnings, however, until these warnings are verifiable it can lead to misinformation (Living on Shaky Ground, 2011). Planning for the hazard of tsunami first requires knowledge that the hazard exists. Knowledge of the global hazard must be translated to local areas at risk, with individual hazard mitigation specialized for each individual community.

Geologic Evidence of Previous Earthquakes and Tsunamis

Worldwide, earthquakes are the most common cause of tsunami. Tsunami may also be caused by underwater landslides and rarely by a meteor impact (Universe Today, 2010). A tsunami is a series of waves usually caused by undersea earthquakes which change the shape of the seafloor. If the seafloor is raised, as in a subduction zone earthquake, the sea surface water seeks to be level and collapses under gravity, producing a series of waves, creating the tsunami (National Tsunami Hazard Mitigation Program, 2005). An earthquake generates a tsunami if it is of sufficient force to cause a violent movement of the sea-floor which causes sudden displacement of a massive amount of water. Tsunami have very long wave lengths, sometimes as much as 200 miles (National Geographic News, 2011). This means that the surges of the tsunami crests may be as much as a half-an-hour apart and may continue for many hours. When tsunami enter shallow water, as they approach land, the waves increase in height endangering the

populations that inhabit the low-lying areas along the shoreline (Atwater, 2005).

Earthquakes occur because of faulting of the earth's crust. The surface of the earth consists of plates which are in constant motion, but which can get stuck at the edges, as the rest of the plate continues to move. An earthquake occurs when the strain builds up to the point where the rock in the fault breaks and the two sides move causing the earth to shake. There are three main types of faults. The angle of the fault in relation to the surface (known as the dip) is used by geologists to classify faults. Faults that move along the direction of the dip plane are dip-slip faults. Strike-slip faults are nearly vertical fractures. In earthquakes caused by strike-slip faults, the ground motion mostly moves horizontally as the plates slide past each other (USGS, 2000). Dip-slip faults are described as either normal or reverse (thrust), depending on their motion. In an earthquake on a normal fault, one side of the fault moves downward. In reverse faults, ruptures move one side of the fault up vertically. Thrust faults are a type of reverse fault (USGS, 2012). A mega-thrust is a powerful earthquake which occurs along a subduction zone and is caused by two lithospheric plates, the outer solid part of the earth's crust, coming together, one riding over the other (USGS, 2000). When this type of earthquake occurs under the ocean, it can produce a tsunami due to the vertical release of energy.

The Cascadia subduction zone is an approximately 1,200 kilometer convergent plate boundary that extends from Vancouver Island, Canada to Northern California. The Juan de Fuca and Gorda plates are subducting eastwardly below the North American plate. The subduction zone is locked and is capable of producing a great earthquake (magnitude greater than or equal to 8.5). The largest earthquakes to occur in the last 100

years were subduction zone event (Atwater, 2005).

Identifying where tsunami may have occurred in the past is challenging. Sedimentary deposits as keys to tsunami character identification and interpretation of sedimentary deposits left behind by prehistoric tsunami can improve our ability to assess the magnitude of tsunami risk in areas with an insufficient historical record. The United States Geological Survey (USGS) has provided expertise and leadership in sediment transport modeling to increase understanding of the mechanics of sediment transport in tsunami and of deposits they leave behind. Research has been carried out in field settings by integrating predictive modeling with laboratory post-event studies (Peters, 2003).

There are at least two ways to use geological science methods to attempt to track historical tsunami events. One can start with the earthquakes that generate tsunami and proceed from there to the resulting locations of coastal impact, or one can begin with known locations of coastal impact. Robert S. Ayre (1975) suggested three relatively simple approaches to the simulation of tsunami impacts at a particular coastal location: (1) the repetition of the sequence of known impacts at that location, (2) the repetition of the tsunami of greatest magnitude known at the location, and (3) the application of a tsunami of the greatest expected magnitude based on a study of all known tsunami impacts at all coastal locations having topography similar to that of the location being studied. However, some experts are not convinced that the geologic evidence is conclusive. The reported evidence of episodic coastal subsidence and associated tsunami deposition has been ascribed by some to possibly represent spit breaches, storm surges, or other aseismic mechanisms (Peterson, 1993). Native American oral history stories

corroborate the past incidence of coastal subsidence (Carver, G. A. 1992).

In fact, another approach to understanding past tsunami occurrence is to study the oral histories of native people living along coastlines. Brian Atwater (2005), professor at the University of Washington, noted that because no written records exist by people living in Northern California before around 1800, history began two hundred years ago on the West coast of North America. Before that time is considered prehistory. However, through his extensive research Atwater has discovered that there is a written record in Japan, where written records were kept since the 1600's, which correlates with Native American oral history and seismic North American geologic evidence of tsunami. By researching these ancient documents of an "orphan tsunami" (a tsunami that is not preceded by a nearby earthquake), Atwater has been able to determine the exact date that a massive earthquake occurred from the Cascadian subduction zone, off the northwest coast of North America. It occurred on January 26, 1700.

Oral History in Action

*Words are gifts, our grandparents say;
and they give us many words
so that we will remain a nation,
a circle of people.*

*Debra Calling Thunder,
Northern Arapaho,
Shoshone & Cheyenne (1993, p.44)*

The knowledge of prehistory passed down through the tradition of oral history is an important cultural resource for Native Americans, a resource that needs to be explored and discovered as well as protected (Underwood, 1993). Memories cannot be communicated and passed on through history without the tool of language (Froebe-Kapteyn, 1973). The concept of time, as we know it, began with the inception of language, for without the social construct of language, we would have no way of conceptualizing our perceptions of time (Brandon, 1971). These stories are somewhat of a mystery, but they are usually told by grandparents and parents to each consecutive generation unfailingly within each tribe and are often intensified by song or performance (Hanzlicek, 1974). The stories are then supported in the culture by rituals and ceremonies (Einhorn, 2000). Oral history in the form of a story is a very good way to pass on needed knowledge to the generations yet to come (Mihe-suah, 1998). These stories can be seen today, as an insight into the values regarding the environmental society and the spiritual world (Martin, 1987).

The source of these stories of tsunami and great cataclysms are the survivors themselves of these previous disasters, intent on passing on their experiences, so that

future generations may acquire the knowledge from their experiences (Einhorn, 2000).

The Native American vision of nature is ecologically meaningful and brings together the human and the non-human world together into a shared reality of detail and enactment (Rothenberg, 1986). The indigenous tribal perspective on tribal histories is likely to be told in relationship to specific landscapes, and is event-centered, usually including a particular person or being who was present, as opposed to Western thought centered around historical data (Shoemaker, 2002).

A story from the Klamath tribe indicates these stories can be thousands of years in the telling. Eighty-year-old Chief Lalek was asked by William Colvig a nineteen-year-old soldier stationed at Fort Klamath in 1865, "Why do your people never go up to the lake? Why are you afraid to look down upon its waters?" The chief told Colvig this story which he had learned from his father, who had learned it from his father. Chief Lalek began telling the Klamath's story:

“A long time ago, so long that you cannot count it, the white man ran wild in the woods and my people lived in rock-built houses. In that time, long ago, before the stars fell, the spirits of the earth and the sky, the spirits of the sea and the mountains often came and talked with my people. The Chief of the Below-World (Mazama) spewed fire from its mouth. Like an ocean of flame it devoured the forests on the mountains and in the valleys. On and on the Curse of Fire swept until it reached the homes of the people. Fleeing in terror before it, the people found refuge in the waters of Klamath Lake. Once more the mountains shook. This time the Chief of the Below-World was driven into his home and the top of the mountain fell upon him. When the morning sun arose, the high mountain was gone. . . . for many years, rain fell in torrents and filled the great hole that was made when the mountain fell”. Chief Lalek ended his story this way: "Now you understand why my people never visit the lake. Down through the ages we have heard this story. From father to son has come the warning, look not upon the place for it means death or everlasting sorrow (Thomas, 2000, pp. 249-251)”.

What could have happened at Mount Mazama to cause this intense reaction in the people? Through recent research, geologists now know that approximately 7,600 years ago, the 12,000-foot summit of Mount Mazama exploded violently. When the volcanic eruption was over, the summit was so weakened that it collapsed almost straight downward, a highly unusual phenomenon, creating a caldera six miles wide and 4,000 feet deep, over the centuries, rain and snow eventually created Crater Lake, Oregon that we see today. It is the deepest lake in North America. How did the Klamath elders know how the lake was formed, long before geologic science had developed its explanation of a volcanic eruption, if not from experience? Recent archaeological excavations in Oregon have uncovered the remains of a 9,000 year old house, the oldest dwelling yet found in North America. The house itself was buried under volcanic ash from the Mount Mazama eruption. This archaeological evidence indicates that Native Americans were here in residence in North America at the time of the Mount Mazama eruption (ibid). It is possible therefore, that the immensity of this cataclysm entered the oral history then and has remained in the oral history of the Klamath tribe for over seven thousand years!

These stories are not just myth, they are the perception of reality passed down generation after generation by the oral tradition since the beginning of language. The tradition of oral history is scoffed at by some European Westerners as impossible, but to some Native Americans the so-called facts of science are myth (Dubin, 2002).

In *Red Earth, White Lies* (1995), Vine Deloria Jr. offers a radical new alternative to standard science-based explanations of Native American origins. He argues that Native Americans have occupied the Western Hemisphere for an extremely long period of time,

and that immense knowledge regarding past migrations, ancient geologic and climatic events are preserved in the traditions of Native American tribes. He also points out that the Western world only accepted that Homer's poetic accounts were grounded in historical fact only after Heinrich Schliemann discovered and excavated the archaeological site of Hissarlikand. In fact, some of the world's most honored literary masterpieces, such as works by Homer, have come from the same conditions that apply to most Native American literature, such as the oral tradition, translation and uncertain authorship (Brandon, 1971). In his book *Skull Wars* (2000), David Thomas writes about the divergence between native thought and scientific evidence, he states that although research into oral tradition and the archaeological record have some parallels, there is one important difference, archaeologists can often find corroborative information through oral history, however, Native Americans rarely feel the need to corroborate their own oral history. In most instances, Native People have had little to say about the translations, interpretations and analyses developed from the stories they willingly shared (Mihesuah, 1998). The Native American's tenuous existence gives language and the oral tradition great importance because no matter how many times a story has been told, it is but one generation removed from extinction (Einhorn, 2000). With many oral history traditions, extensive testing and training of memory was required before one was even invited to hear what one may become responsible for one day, including the stories passed down regarding great events such as tsunamis (Underwood, 1993).

This excerpt from a Tolowa story tells of a great tsunami that happened in Oregon:

There were no white people on earth when it happened. Chetko is where it happened. It is called Brookings now. Chetko or Chet is the Indian name. Two children ran in the house... and told their grandmother "Dog spoke," and they told her what dog said. The grandmother told the children to go right away, to go as fast as they could and not to wait for anybody. She would stay. She was too old and was ready to die anyway. She told the boy to take his fish net and his money. So the boy took the fish net and the money and the two children ran as fast as they could, upstream, away from the harbor toward Mount Emilie as their grandmother had told them. Halfway there they looked back. They could hear the people cry. They could hear the cries rise and sink out. They could see the water come. When they reached the top of the mountain, all the things in the woods which have names were there, deer, rattlesnake, panther, everything. The boy made a fire and they all sat around it. All night they sat around the fire on top of the mountain. When the sun came up it (water) had all gone away. The brother and sister stood up. Everything was gone. They went back to where their house had been. There wasn't anything there, no dead people. Everything was swept away clean. The ocean was nice and smooth. Everything was pretty. There was no wood to build a fire. The boy went down to the beach to fish. He saw far away someone slowly coming toward him. It was a girl. He went to meet her. They got married and people started again (Debois, 1932, p. 248)

In my analysis of this tsunami story, several concepts became apparent to me. Prehistoric Native Americans who were naturally much more connected with the natural world, had already learned that even the slightest deviations from normal in animals, and other aspects of nature were something not to be ignored. They respected nature. Also, assuming that this myth was in reference to the 1700 Cascadia subduction zone earthquake, then the two children in this story survived that tsunami, and the Tolowa tsunami story known by the grandmother *must* have been about a tsunami that occurred previous to the Jan. 26, 1700 tsunami, because the grandmother already knew what was about to happen.

In the story, the dog was the first one to become aware of what was about to happen. Lori Dengler, Ph.D., professor of geology at Humboldt State University (HSU) has theorized that animals may be able to perceive the p waves that precede the actual ground shaking that is perceived by humans. Dengler earned her doctorate in geophysics at the University of California, Berkeley in 1979, the same year she joined the faculty at HSU. She is one of the founding members of the RCTWG and is their scientific advisor. She has participated with several post-earthquake/tsunami reconnaissance teams, including Sumatra, Indonesia 2004, Chile 2009 and Japan 2011 (HSU, 2011). She believes the disparity of how animals react to earthquakes and tsunami in relation to how humans react is simple; humans are curious and tend to respond to unusual phenomena by going closer to investigate, while animals will tend to run away from strange (Dengler, 2007, personal communication).

According to recent research by Motoji Ikeya (2004), editor of *Earthquakes and Animals—from Folklegends to Science*, at least 15% of dog owners questioned after the Loma Prieta and Kobe earthquakes reported abnormal behavior in their animals prior to these quakes. Observing animal behavior, as was recorded in the oral history tsunami story, may add to the understanding of earthquake and tsunami prediction in the future as an early warning system for humans (Funk, 2005). But there are other natural warning signs of tsunami that are more obvious, such as intense ground shaking, or the receding of the ocean that are therefore more accessible to our perception.

A recent example of the lifesaving power of oral history occurred during the 2004 Indian Ocean tsunami tragedy. Weeks after the tsunami, relief workers ventured out to the

remote island of Simeulue, expecting massive loss of life, due to its close proximity to the 9.0 earthquake. But these Indonesian islanders, partly because of their remoteness, had not lost the power of the oral tradition from their culture and it had the power to save their lives. The ground shook so hard that people couldn't stand up when the massive earthquake rattled the island. This island was the closest inhabited land to the epicenter of the devastating temblor. But unlike the hundreds of thousands of others who thought the worst was over when the shaking stopped, the islanders remembered their grandparents' warnings and fled to higher ground in fear of giant waves known locally as "semong". Within 8 minutes Simeulue Island became the first coastline in the world to experience the awesome force of the Dec. 26 tsunami. The earthquake itself lasted ten minutes, meaning the islanders began to run well before the earthquake had stopped. Only seven of the island's 75,000 people died, thanks to the stories passed down over the generations. Their oral history recounts a massive 1907 tsunami and advises running for the hills after significant ground shaking. All the interviewed Simeulue survivors knew of this event and of the necessary action. Simeulue's oral history provided an extraordinarily powerful mitigation tool that saved countless lives where even a high-tech warning system with a 15 minute response time would have been of no help (McAdoo, Dengler, 2006). Islanders say they will tell the story of the semong down to future generations, even if another disaster never happens. Taufik, who like many Indonesians uses only his first name, and is an Indonesian official for the meteorological and geophysical agency, noted that Simeulue's lush hills are close to the coast, allowing people to get to safety. In many other places with broader coastal plains people had fewer places to run (Taipei Times,

2005). To me, the most important thing about this article in the Taipei Times, was the recorded use of wheel-barrows, hand carts and bicycles to rescue small children, the disabled and elderly adults, who were evacuated to higher ground by these means.

In summation, the power of the oral tradition can transcend time. The stories gain momentum over time if told and retold again. These stories of tsunami and other geologic disasters hold a specific significance for us now in this place and this time. We owe this perspective into our possible future to the care and intelligence of past generations who valued our existence enough to try to protect it, even though we had not yet been born. This is an example of how oral history can be seen as cultural and social capital for future generations, not just right now, or for the people currently existing. The Native American ancestors perceived their world as responsibility over time. These stories of tsunami have saved and will continue to save many lives, if not forgotten. The problem is, many of the stories have been forgotten. Many coastal inhabitants are still unaware that they are living in a potentially dangerous tsunami hazard zone.

Social and Cultural Capital

Social theorists have generally defined social capital and cultural capital, as resources that inhere in social relationships. These resources include mutual trust, a sense of reciprocal obligation, and civic participation aimed at benefiting the group or community as a whole. As such, social and cultural capital are construed to be properties of groups or communities, not of individuals (McLean, 2002). Social capital provides a web of interconnectedness between people which can act as a safety net for the

community when important information and knowledge are required. This knowledge is for the benefit of the entire community to be shared. The closer knit the web, the easier information can pass along it.

Social capital resists simplification, it varies widely, dependent on its place in time. Indeed, it must be heard in dialogue with local voices, seen against the background of individuals, families, and communities (Saegert, 2001). Community engagement and voluntary associations are described as important generators of social capital, resulting in the enhanced performance of communication and instilling in its members habits of cooperation (McClellan, 2002).

Cultural capital consists of the values of a society reflected in the traditions, the history, art, symbols and goods of that culture (Fey, Bregendahl & Flora, 2003). The tradition of oral history is a good example of cultural capital.

Ecosystems

An ecosystem can be defined as a biotic community, along with the physical environment within which each organism of that community interacts. Ecosystems are complex interactive systems that may vary in size from microscopic to the biosphere. Ecosystems can be relatively healthy or unhealthy depending upon our subjective perceptions of what is healthy. Human activities may influence the relative health of an ecosystem, be it through disturbance or conservation (Brunson, 1997). Because of these human interactions, the practice of ecosystem management is much more difficult than traditional resource management (US Army Corps of Engineers, 1998). Postmodern

society tends to value nature as an aesthetic amenity and not necessarily as the ecosystem that sustains our existence. Ecological health assessment today must include human activities as part of the ecosystem. Ecosystem services, such as clean water, clean air and natural habitats provided by an ecosystem to humans can be a sign of its relative health (Brunson, 1997). Humans are more likely to take care of something that is valued. Today, true conservation of environments must include the human activities of the particular community and ecosystem.

Ecosystems do not exist apart from time. According to Marina Michaelidou, there is a difference between health and integrity and that both of these need to be considered in both space and time (2002). When studying an ecosystem we need to be aware of its "time-body", i.e. its past, present and future. We need to prepare for possible future disasters based partly on the history of the place. Sometimes the knowledge of that history lies in the scientific examination of empirical evidence, sometimes it survives in stories.

BIG LAGOON ECOSYSTEM

Big Lagoon is a small community located in northern Humboldt County, California. It is 15 miles south of Orick and 7 miles north of Trinidad. The closest large city is Eureka (see map, appendix A). The elevation of the area varies from sea level to 110' above sea level (USGS, 1978). Much of the area, including the housing, is located within the tsunami hazard zone (Humboldt County Office of Emergency Services, 2012).

The lagoon itself has problems with excessive sedimentation and high temperatures. Nonpoint source pollution usually from storm water, agricultural runoff and logging are the greatest causes of water quality problems in Humboldt County. Big Lagoon experiences this problem of nonpoint pollution due to Highway 101 runoff and the after effects of logging practices on the watershed, such as over sedimentation (Hansis, 2005, personal communication). Global warming contributes to higher water temperatures and toxic algal overgrowth which has been occurring more frequently in recent summers (Paerl, 2008, Smith, 2006). Several dogs, in recent years, have been poisoned to death in Big Lagoon by the toxic algae (Times Standard, 2011).

Big Lagoon School

Big Lagoon School is a rural elementary school serving grades k-8. The school serves a small population of approximately 55 students. The school is located in a quiet community within walking distance of the Pacific Ocean and Big Lagoon (Big Lagoon School, n.d.). The school itself is located between 80' to 100' elevation above sea level and is outside the tsunami hazard zone (USGS, 1978). The school is located off of

Highway 101 at the Big Lagoon Park Road turnoff, north of Trinidad. The campus consists of 6 classrooms, computer lab with 24 computers, resource room, teachers room, library, office, restrooms, a large gymnasium/multipurpose room, bus garage, gravel parking lot, garden, boat storage area, soccer field, playground equipment, native plant woodland and spruce forest. The surrounding area contains a variety of habitats including forest, marsh land, dunes, peat bog and tule marsh (Big Lagoon School n.d; personal observations over time). The Big Lagoon School District was established October 5, 1881. It lapsed as a district November 12, 1919 and was included? into the Stone Lagoon and Patrick's Point District. It was re-established as a district in 1958 (Humboldt County Office of Education, 2006).

The ecosystem surrounding Big Lagoon School consists of a spruce forest with mature understory of native species including one species of rare orchid. The forest is owned by the Green Diamond Company, and is being loaned to the school to provide a nature trail for the school (Big Lagoon School, n.d). A wide variety of fungi occur in abundance there seasonally. The fall is the most prolific time for these organisms to fruit. The forest was logged 80 years ago, and now consists of an 80 year old even-aged spruce forest (Hansis, 2005, personal communication). A few specimens of several other species of conifers complete the forest. A small creek, called Maple Creek flows through the forest and empties into Big Lagoon on the south end where it supports a small wetland area and peat bog which hosts two species of native carnivorous plants (Proust, 2000, personal communication). Walking into this forest is an awe-inspiring experience and is the first time "in the woods" for many children. The trail from the school is surrounded

by huckleberries, salal and several species of ferns. It leads into the stand of Sitka spruce trees. The ground is literally covered in a dense growth of moss in most places. The trees are close together, and are very tall and slender, reaching up into the available light. Plants living in the understory include red and black huckleberries, salmon berry, thimble berry, licorice fern, sword fern, fiddle head fern and skunk cabbage (personal observations over time).

Big Lagoon County Park

Big Lagoon County Park is located on the southwest side of the lagoon. The entire park, including the campground is located within the tsunami hazard zone from sea level to an elevation of 30' above sea level (USGS, 1978). The park which is comprised of many different habitats, from forest to ocean, provides camping, picnicking, beach combing, a boat launch, short pier and other ecosystem services such as kayaking, canoeing and windsurfing. Fishing for steelhead and trout are popular activities as well. The area is great for birding. The mixed flora provides a variety of habitats for local and migrating bird species. Downed wood in the forest supports birds such as the pileated woodpecker (personal observations over time).

Although the Big Lagoon peat bog, located within the county park, has been studied by the HSU Herbarium (HSC), no focused survey of the peatland exists. There are rare species of carnivorous plants living there, as well as alien taxa in the bog because of prior disturbance. Houses occur within 100 meters of the site and much of the forest directly adjacent has been logged and grazed in the past. Peatlands provide habitat for

rare and regionally uncommon taxa. The Big Lagoon site has eight documented rare plant occurrences (California Native Plant Society, 2001; California Natural Diversity Data Base, 2002). Many of these rare taxa occur as highly aggregated and often disjunct clusters. These aggregations highlight the strong association of rare taxa with California's few peatlands. Continuing threats to northern California peatlands include altered hydrology, development, invasive plants, global climate change, and wetland filling. Freshwater wetlands are especially vulnerable to climate change because alterations in the amount of timing of precipitation and evapotranspiration could cause them to become drier (Leppig, 2002). This fragile ecosystem is also under the threat of future tsunamis (Nicolini, 2010, personal communication).

Big Lagoon Rancheria

The cultural timeline for the Big Lagoon area begins with a prehistoric Native American village. The Yurok still live along the North Coast of California, including the southern shores of Big Lagoon at the Big Lagoon Rancheria (Yurok Tribe, 2012). The Big Lagoon Rancheria is the smallest rancheria in California. There are approximately 28 Yurok residents currently living at the rancheria (Lara, 2010, personal communication). Several of the homes are within the tsunami hazard zone. The elevation on the rancheria ranges from sea level to 88' above sea level (USGS, 1978).

The Yurok, Hoopa and Karuk are a few of the tribes still residing in Humboldt County. Although these tribes were not agriculturalists, they were horticulturists, using native plants for food, medicine, and fiber and using controlled burn fires to nurture the

most useful plants. These were some of the ways the Native Americans managed and utilized their ecosystems (McCovey, 2006, personal communication; Yurok Tribe, 2012). Yurok tribal members still gather edible mushrooms, such as chanterelles and basket making supplies, such as spruce roots from the forest at Big Lagoon, parts of which are within the tsunami hazard zone, so it is important that the information regarding the tsunami hazard is further communicated within the Yurok tribal members, as many are yet unaware of the oral history stories (ibid).

When a large earthquake occurs just off shore along the Cascadia subduction zone, a tsunami could possibly arrive at Big Lagoon in 10–30 minutes. All residents, children and teachers need to be aware of this time frame. Continued education and training for all personnel and students at Big Lagoon School and the residents of the community should be implemented at the beginning of every school year, so that every new kindergartner or new student is educated about the tsunami hazard, as to be prepared for such an event.

THE PROJECT AT BIG LAGOON

The purpose of this project was to educate and prepare the residents of Big Lagoon, California so that they know what to do and where to go in the event of an earthquake that could cause a locally generated tsunami or when alerted by siren, weather radio or social media communication of a distant tsunami.

One of the reasons I chose the Big Lagoon community for study is my past personal experience with the area as a parent, an employee at Big Lagoon School and an involved community member. I began working at Big Lagoon School in 1992, when my youngest child entered kindergarten there. My other two children were already in attendance. During this first year of employment I "wore many hats" as cook, yard duty attendant and substitute school secretary. In 1992, while I was the acting secretary, I received a phone call from an official at the National Oceanic Atmospheric Administration (NOAA) informing us of a tsunami warning that had been issued for our area. She said that it was probably nothing to worry about, that the tsunami was probably only going to be six inches high. I immediately informed the principal, who acknowledged it but did not seem in the least concerned. As my further research suggests, more concern was warranted. What we didn't know, was that tsunami gain height exponentially over distance and it is feasible for an initial three foot tsunami to become a one hundred foot high wave (Atwater, 2005).

In 2000, eight years later, I was again to encounter concerns about the risk of tsunami at Big Lagoon. My son James, then aged thirteen, undertook a study of the peat bog adjacent to Big Lagoon for the Humboldt County Science Fair. The project was to

investigate the bog by taking core samples to see if there was a layer of sand, possibly indicating the past occurrence of tsunami activity. His 8th grade teacher Geoff Proust, James and I went on an expedition into the bog with a homemade coring device made of PVC pipe with attached leverage handles, enabling intact core removal from the bog. After we got the samples, we consulted with Dr. Jeff Borgeld, geologic oceanographer at HSU, about the process, and he suggested we examine some of the sand core samples under the microscope for evidence of zooplankton which only occur in ocean water, a single celled marine zooplankton with a perforated chalky shell called foraminifera (Li, 1992). We did so, and we found foraminifera in the samples. This brought forward the possibility of a previous tsunami. Because this was a child's science project, the results were not widely known. However, during the interview with Borgeld, he mentioned previous studies conducted on the swampy areas near Klamath which indicated past tsunami activity. He also mentioned knowledge of local Native American oral history of a tsunami with devastating consequences. He prophetically commented that this study seemed more like a master's degree thesis, rather than an 8th grade science project. My son's project was recognized with a Special Award at the Humboldt County Science Fair.

Five years later, when I was accepted into the Environment and Community Master of Arts program at Humboldt State University, tsunami education and readiness at Big Lagoon became the focus of my project.

PROJECT METHODOLOGY

I began an initial report on the ecosystem health of the Big Lagoon area in September of 2005, when I had just begun this master's program at HSU. My teenage sons and I went to look for macro-invertebrates (insects) in the creek which runs through the spruce forest at Big Lagoon School. Some macro-invertebrates are signs of a healthy ecosystem, while others are signs of an unhealthy one. However, we were surprised to find no macro-invertebrates whatsoever in the creek. The creek was totally void of macro-invertebrates because the bottom and sides of the creek were entirely composed of sand with no decomposing soil to support macro-invertebrate life. It suddenly became apparent to me that the sandy creek we were examining contained sand deposits much further inland than the peat bog, further inland, but at a lower elevation than the site occupied by Big Lagoon School. Though my research was preliminary, it was then that I decided that my research should be shared with the administration of Big Lagoon School, even if it was inconclusive and based on amateur knowledge and Native American oral history only, (comprehensive tsunami inundation maps of the Big Lagoon area had not yet been produced). I presented my initial findings to Kim Blanc, principal of Big Lagoon School, in March, 2006. Even though the school buildings are outside the tsunami hazard zone, the children attending the school regularly take field trips down to the beach and through the forest down to the sandy creek and there wasn't a tsunami evacuation plan. That month my first research paper was included in the school board packets to inform the board members of the risk.

My methods included the study of Native American oral history, historic records,

previous geologic studies, personal interviews, and personal observations over time. Initially I approached the Big Lagoon School Board, presenting my research that the students were in danger of a tsunami when they went on their weekly field trips down to the lagoon and that precautionary measures were necessary.

As my research continued, I became aware of the existence of the Redwood Coast Tsunami Work Group (RCTWG). This is an ad-hoc group consisting of members of many different local, state and national government agencies, such as HSU, NOAA, HCOES and Redwood National Park, as well as other interested non-governmental parties, such as the Red Cross, Trinidad Rancheria, PG&E, students and community volunteers. The RCTWG was formed in July 1996 to define the needs of local communities to mitigate the North Coast earthquake and tsunami hazard through education, planning and outreach. The RCTWG provides a coordinated and consistent mitigation program for the coastal communities of Del Norte, Humboldt and Mendocino Counties. The meetings are held every two months and are hosted by alternating agencies including the National Weather Service, Redwood National Park, the Klamath Tribe, the Trinidad Rancheria and the Crescent City Office of Emergency Services. Recently, new tsunami inundation maps were produced by the Humboldt county Office of Emergency Services (HCOES) in association with the RCTWG. This is an example of the care and education taken by the Humboldt County community at large through the auspices of the RCTWG to educate and prepare local communities for the possibility of a tsunami. The more we all become aware as individuals, the more we will be able to contribute to the awareness of our local communities (RCTWG, 2006).

As I began attending the meetings of the RCTWG, I gained the information, networking skills and possibilities to begin the education and planning process within the Big Lagoon community. It was a challenging process, partly because of the many different entities that exist in the Big Lagoon community, including Big Lagoon School, Big Lagoon Park Company, Big Lagoon Rancheria, Humboldt Lagoons State Park, Big Lagoon County Park and the Green Diamond Company. I began the process as an inclusive one, but I soon realized that there were different risks and planning issues for the different areas of the community. In addition to attending Big Lagoon School board meetings I also attended Big Lagoon Park Company board meetings and made contact with the members of the Big Lagoon Rancheria and the field crew of the Big Lagoon County Park. I then arranged to meet with some of the members of the RCTWG, including Lori Dengler, Vicki Ozaki and Troy Nicolini, to evaluate possible tsunami evacuation routes in the area. We met at the Big Lagoon County Park boat ramp. This meeting was also attended by Don Tuttle of the Big Lagoon Park Company, Tom McDonald from Green Diamond, Shane Harmon from Big Lagoon School and Xavier Morales from the California State Parks. Other meetings were held on the Big Lagoon Rancheria with Roger Lara, Big Lagoon Rancheria Environmental Specialist to map out evacuation routes there.

Inspired by the process of oral history as a means of using stories to transmit important survival information, I utilized modern means of story dissemination such as pamphlets, press releases to local newspapers and local television coverage which was posted on the internet to get the word out about the tsunami risk at Big Lagoon.

Beginning with this very first meeting at Big Lagoon with members of the RCTWG, I wrote and submitted a press release with a photo which was published by the McKinleyville Press (see Appendix B). I then produced pamphlets specific to Big Lagoon and the Big Lagoon Rancheria using the pamphlet *Tsunami* prepared by Humboldt Earthquake Education Center, Humboldt State University (January 2008) as a template so that a consistent message was being presented (see Appendix C). A map of the Big Lagoon area was placed on the back of the pamphlet (see Appendix D). The pamphlets were distributed to all the residents of Big Lagoon and were sent home to the parents of students at Big Lagoon School.

After the best evacuation routes were established, based on the quickest inland route to higher ground, I began the process of working with the National Weather Service (NOAA) to provide signage to inform the residents of the tsunami hazard and of the best evacuation routes. I then began the process of doing annual tsunami evacuation drills, with each area of the community, so that the community members become familiar with the routes before an actual event. This process helps to build "muscle memory", making it easier to take appropriate action without having to think about what to do when an earthquake occurs (see Appendix E).

Becoming a TsunamiReady Community

The goal of this project was to educate the community on how to become "TsunamiReady". TsunamiReady is a registered trademark of the National Weather Service through the auspices of NOAA (see Appendix F). The requirements for a

community to become TsunamiReady are as follows:

- 1.) Establish a 24-hour warning point and emergency operations center
- 2.) Have more than one way to receive tsunami warnings and to alert the public.
- 3.) Promote public readiness through community education and the distribution of information.
- 4.) Develop a formal tsunami plan, which includes holding emergency exercises.
- 5.) Arrange a Verification Visit(s).
- 6.) Receive approval of local advisory board action.
- 7.) Congratulations! Conduct recognition ceremony!

When the criteria are met, a community becomes acknowledged as officially TsunamiReady (NOAA, 2004).

During the organizing phase of the first tsunami evacuation drill for Big Lagoon School attended by Dengler, Nicolini and Ozaki, I invited the local news team to cover the drill as a human interest story. It had been mentioned at a RCTWG meeting that the media were getting tired of the tsunami coverage, and it had become harder to get their involvement, so I expended some of my own social capital, as my husband, William Zoller, worked for KIEM TV at that time on the tech crew, so indeed they did come out to do the story. The story aired that night on KIEM News Channel 3. It featured interviews with Dengler, Nicolini and me about the importance of tsunami awareness. Some of the children were also interviewed about their evacuation drill experience. The children were excited about being on television. It was a well written and informative news production.

According to TsunamiReady guidelines (NOAA, 2004), all evacuation routes must fit the criteria of being able to provide access to the evacuation site within 10 minutes at a walking pace, as the first wave of a locally generated tsunami from the

Cascadia subduction zone could arrive on the shores of Big Lagoon in as little as ten minutes (Bernard, 1998). Roads will most likely be damaged by the earthquake and could be impassable to motor vehicles, so it is important to go on foot (Hebenstreit, 1997; RCTWG, 2006).

One way to minimize the risk to the children at Big Lagoon School is to make sure that every child and every staff member at Big Lagoon School is educated about the natural hazard warning signs and knows how to react immediately if a threat is perceived. I informed the school board about the necessity of having a way to move very young children or disabled children away from the beach in a hurry, such as a gardening cart on bicycle wheels that could be used for immediate evacuation to higher ground, as was done on Simeulue Island in Indonesia.

The children of Big Lagoon School and the children of Big Lagoon Rancheria have been told the empowering story of Tillie Smith. Ten year old Tillie Smith remembered the natural warning signs taught to her by her geography teacher shortly before vacationing with her British family in Thailand on Dec. 26, 2004. She noticed that the ocean appeared odd, with small bubbles forming on the beach. She recalled her teacher saying that a strange appearance of the ocean could be a sign of an impending tsunami and that there could be as little as ten minutes between the time the ocean recedes and the arrival of the tsunami. She told her mother and began to run for higher ground, alerting locals and hotel guests as she ran, saving the lives of at least 100 people (Funk, 2005). Children need to know that they are responsible for their own well-being, just as Tilly Smith did during the 2004 Indian Ocean tsunami. This can be an empowering

experience for children rather than a fearful one.

Other community members, including the residents of the Rancheria, the residents of other housing as well as tourists visiting the beach also need to become more aware of the hazard and need to keep realizing that they themselves are the first responders. I have assisted this process of becoming TsunamiReady through community education, comprehensive planning meetings held within the community at the Big Lagoon School facilities, through appropriate signage, tsunami evacuation maps and tsunami evacuation drills conducted in association with members of the RCTWG. Troy Nicolini, current director of the Eureka branch of NOAA, has emphasized the importance of a devoted individual to help lead and motivate a community to become TsunamiReady.

TsunamiReady Ceremony

A ceremony was held on March 26, 2010 to proclaim the community of Big Lagoon and the Big Lagoon Rancheria to be TsunamiReady. It was held at Big Lagoon School at noon so that all the students could attend the ceremony. The signs reading "TsunamiReady Community" were presented by Nancy Dean, director of the Eureka branch of the National Weather Service to Roger Lara, Environmental Specialist for the Big Lagoon Rancheria and Don Tuttle, President of the Big Lagoon Park Company. It was also attended by Jim Goltz, California State Director of Emergency Services as well as members of the RCTWG, American Red Cross, HCOES, and Americorp (see Appendix G). The ceremony was concluded with the serving of a homemade "Tsunami Cake" for all (see Appendix H). The ceremony was covered as a human interest story by

KIEM News Channel 3 and was broadcast that evening. Big Lagoon is currently the smallest TsunamiReady Community in California, an example of the RCTWG's grassroots philosophy that even the smallest community at risk deserves education and outreach.

DISCUSSION

The Strength of Social Capital at Big Lagoon

The community of Big Lagoon demonstrates the ideals of social and cultural capital, that which consists of community social networking and connectedness. The civic organizations such as the school, county park and rancheria are all organizations which actively participate in the community. Identifying community values, involves all interest groups, from conservationists to developers and must be derived from the community, not from scientists (Rapport, 1998). The various interest groups in the area surrounding Big Lagoon are very diverse. These groups consist of Big Lagoon School, the residents of the Big Lagoon area, including residents of the housing at the Big Lagoon Park Company and at the former Simpson Timber Company (Green Diamond Company), Big Lagoon County Park, Humboldt Lagoons State Park and the Yurok people of the Big Lagoon Rancheria. These diverse groups have differing concepts of societal values, the traditional values that order a society.

Social capital acting as a sense of responsibility to the community as a whole over time is apparent in the tradition of the oral history of the Yurok people. These stories can be regarded as social and cultural capital over time. They point to a time in the past when people thought of relationships through time, something I believe is a very important aspect of social capital that we today in our fast-paced attention deprived world have forgotten and can hardly even imagine. It is the strength of the social capital in the Big

Lagoon community that contributes to its health, in terms of its citizens' relationship to their environment and to each other.

This rich cultural tradition has resulted in the ability of the community to be more receptive to new knowledge, education and planning within the Big Lagoon community. The many diverse groups comprising Big Lagoon have all learned to coexist within a very small area and are communicating with each other to further the well-being of the whole community, be it by the school, the county park, the rancheria or the residents, all participate together as stakeholders in their own preparedness for tsunami. Because of this tradition of cultural capital, including oral history, the Big Lagoon community will remain receptive to new knowledge and changes in planning over time, especially as new knowledge becomes available through the studies of the Tohoku quake. The accumulation of social and cultural capital among the members of the Big Lagoon community, as witnessed by the rancheria through the maintenance of traditional values, even in adversity, and the acceptance and respect of those values by the community as a whole, has allowed this community to remain healthy and willing to adapt when important information demands change. Another aspect of the web of interconnectedness of social capital is location over time. As I have shown, the oral history of the Yurok and other tribes is an example of this. Without the recognition of this true social and cultural capital, as in the practice of the tradition of oral history, important knowledge can be lost without ever benefiting the community as a whole.

Yurok Oral History

The Yurok people, throughout their ancestral territory, once occupied more than fifty villages. They regard themselves as great fishermen, basket weavers, canoe makers, singers, dancers, healers and storytellers (Yurok Tribe, 2012). Some of the stories that were told were explanations of great earthquakes and tsunamis. The Yurok people considered Big Lagoon (Oket 'o) to be the *axis mundi*, the center of the world. In the book *Yurok Myths* (Spott, & Kroeber, A.L., 1942) is Ann's story about earthquakes. Ann's brother Tskerkr was also a contributor to *Yurok Myths*. In their accounts, they stated that the earthquake traveled up and down the coast sinking the ground until the prairies were submerged. This account of subsidence is especially notable because the locations identified by Ann are also sites where paleoseismic studies have found stratigraphic evidence of coseismic subsidence. These locations include Humboldt Bay, Big Lagoon, the mouth of Redwood Creek, and the coast north of the Rogue River in Oregon (D. H. Carver, 1998). In addition to coseismic subsidence, evidence of liquefaction was also found at Big Lagoon after the 1980 Trinidad earthquake (G.A. Carver, 1992).

This is an excerpt from another Yurok story, *The Inland Whale*:

Fanny watched intently as the surf from an incoming tide seemed to push back the river and to overspread the wide river mouth. "You see there what is wrong with the world," Fanny said to me, pointing to the breakthrough." The earth tips too far and the ocean comes up the river. That is not good. Even whales could come into the river when it is this way. It happens because there are not enough Yurok anymore; not enough people dancing and stamping their feet down hard on the earth. That is what used to keep it from tipping, and what kept whales outside where they belong (Kroeber, T. K. 1959, p.162).

Rituals and dances were necessary to keep the Yurok world in balance (Yurok Tribe, 2012). Native American elders do not regard their oral history as mere reminiscence. It is a very deep responsibility. Active participation in rituals and accepting personal responsibility are frequently aspects of oral history (Dubin, 2002). This responsibility toward community well-being can be expressed today through comprehensive tsunami preparedness planning, including dissemination of knowledge through pamphlets, drills and appropriate tsunami hazard zone signage.

The Trouble with Signs

The installation of the tsunami evacuation route signs proved to be much more complicated than I initially anticipated. Immediate resistance to the community signs was expressed by members of the Big Lagoon Park Company. Their first concern was visual clutter, as many residents regard the views from their cabins as one of the ecosystem services and benefits of living in this community. Another concern was that posting signs stating the existence of a "tsunami hazard zone" would lower property values. One member, a lawyer, didn't want the evacuation site sign installed, as he saw it as a liability if the site didn't prove to be a safe site outside of the hazard zone. Also the best established tsunami evacuation route was located through a private neighborhood and the residents didn't want "transient" populations walking by their houses.

On the morning of the ceremony to declare Big Lagoon TsunamiReady, I went to double check the evacuation route signs. I discovered that residents had taken it upon themselves to move the signs and had turned the directional arrow accompanying the

evacuation route sign so that it pointed toward the ocean!

Another problem with the signs was that they were being stolen almost as quickly as they were being installed because they are regarded as "cool" and are a much desired commodity for dorm room decor. At this writing, the RCTWG was attempting to address this issue by having facsimile evacuation route signs manufactured for sale to hopefully reduce theft.

There were also communication problems about the signs with the Humboldt County parks maintenance crew and supervisors regarding the initial installation of the signs. The supervisor in the field gave me the okay to install the signs, which I did, but apparently his supervisor was not aware of this permission. When I asked to install more route signs from the campground, I was informed that all signs within the Humboldt County \parks had to comply with official rules about size and format. There is now a coordinated effort with the county parks to have consistent signage in coordination with the RCTWG.

I installed all of the signs in the community on existing posts, including P.G. & E. poles and trees, which I was told afterwards wasn't allowed and that I might be asked to remove them. So far those signs still remain, reminding me of the old adage, "It's easier to get forgiven than it is to get permission". I wanted to use existing posts partly because of the special circumstances involving post installation within the Big Lagoon County Park. Part of the park is located directly above the ancient Native American (Yurok) burial ground, so any digging into the ground must be supervised by an archeologist representing the tribe to insure the preservation of any artifacts that may be unearthed.

Campgrounds as an Additional Hazard

One issue to be dealt with came to light after members of the RCTWG, Dengler and Nicolini returned from their reconnaissance mission to Chile. The tsunami there occurred during a popular holiday vacation when many people from inland towns had come to the seashore to camp. While many local residents were aware of the tsunami hazard, the campers were not. The vast majority of deaths from this tsunami were campers, some on islands with no possibility of escape. This was the worst possible scenario that no one had thought about or planned for.

There is also a low-lying campground in Big Lagoon County Park that is within the tsunami hazard zone. This campground had not been considered as a big problem, as it is unoccupied for most of the year, yet it is occupied by hundreds of people per day during the peak season, just as were the campgrounds in Chile and the beaches in Indonesia during the Indian Ocean tsunami which also occurred on a holiday.

At first the members of the RCTWG thought that there was no viable evacuation route to higher ground from the Big Lagoon campground. However, I returned recently to the campground with one of my sons and he walked the proposed evacuation route in just under ten minutes, as is required to be TsunamiReady. This was a relief to me. Now the county park is working toward installing evacuation route signs in the campground and evacuation map posters have been installed on both bulletin boards at the campground.

Summary

My work to help make the community of Big Lagoon TsunamiReady is an example of how community education can eventually benefit the community that supported the education in the first place, possibly even saving lives. This is an exciting aspect of social science in action. The indicators from oral history, historical and geological perspectives suggest that Big Lagoon is definitely at risk for a tsunami and appropriate attention has now been given to disaster planning in this area. Major earthquakes (9.0) occur about every two to three hundred years along the Cascadia subduction zone. We are currently overdue for another major earthquake with its accompanying tsunami. This is why it is so important to heed the warnings from these oral history stories and to act as community members to educate ourselves and others about the future risk. This indeed is the spirit of the oral history stories, to educate one's community both now and into the future. The residents of Big Lagoon have risen to the challenge of educating and preparing themselves for the possibility of a future tsunami.

CONCLUSION

My project has shown how social and cultural capital investment protects the community at large through the process of environmental awareness and education passed along the community information web, especially when planning for possible disasters. The science of tsunami research is literally changing daily. Since the 2004 Indian Ocean tsunami and the more recent tsunami in Chile and Japan, research efforts have intensified worldwide and new knowledge is being continually added, changing previously held concepts. It is an important time to be pursuing this field of research and education.

A siren has been installed near the boat ramp at Big Lagoon County Park. The installation of sirens in twelve locations in Humboldt County is the result of efforts of the RCTWG, especially Dan Larkin to lobby the Humboldt County Supervisors to acquire grant funding for this project. PG&E also donated siren equipment to this important project (HCOES, 2012). The siren at Big Lagoon will serve as a warning of distant tsunami, tsunami not generated locally, such as the orphan tsunami which hit Japan with no warning on January 26, 1700. No ground shaking was felt in Japan because in that case, the tsunami was generated from the Cascadia subduction zone. These sirens are not designed to provide warning for local tsunami which occur after local ground shaking. The sirens may be rendered inoperable due to the intensity of a local earthquake and possible loss of communications ability. Therefore, the community will need to be re-educated to know the difference between the natural warning signs of tsunami and the warning of the siren. Separate drills for each scenario should be conducted so that the

siren is understood and does not provide a false sense of security. Evacuation drills will be scheduled this spring to coincide with the emergency preparedness drills conducted by the HCOES. The sirens will be activated during Tsunami Awareness and Preparedness Week which is the last week in March annually. Other drills will be scheduled with simulated earthquake activity and no siren (the kids do a shaking exercise on the beach for 20 seconds as if in an earthquake), in October annually to coincide with the Great California Shakeout (Earthquake Country Alliance, 2011), a statewide earthquake drill, so that everyone is aware of both warning signals to evacuate.

The real proof that the planning has been effective at Big Lagoon occurred just after the January 9, 2010 magnitude 6.5 Eureka earthquake which was felt widely throughout the North Coast, including Big Lagoon. I learned that the families of the Big Lagoon Rancheria had indeed immediately evacuated to the tsunami evacuation site on higher ground. I wrote a press release to the *Times Standard* with a photo from the previous evacuation drill to document their accomplishment. It was published in the *Tri-City Weekly* on February 16, 2010 (see Appendix I).

The significance of this project has really come full circle as the Bear Dances have begun annually at the Big Lagoon Rancheria. At the Bear Dances there can be more than 200 people in attendance. The actual place where they occur is well within the tsunami hazard zone. The community has been informed and another tsunami evacuation drill will take place during the next Bear Dance (personal communication Lara, 2012). At one of the most recent evacuation drills on the Rancheria, I read the story of the *Inland Whale* where Fanny speaks of there not being enough Yurok anymore dancing and

stamping their feet hard on the ground to keep the earth from tipping. Well, now there are Yurok dancing again and with the renewed wisdom of their ancestors' knowledge of the oral history of tsunami.

Considering the possible loss of life when an earthquake occurs along a subduction zone with its accompanying tsunami, as witnessed in the Indian Ocean tsunami and the tsunami in Chile and Japan, there is no denying what is at stake if people are not educated and informed about a possible tsunami. The education and preparedness at Big Lagoon assumes even greater importance in light of these recent tsunami.

ADDENDUM

On October 27, 2010, I was presented with the Redwood Coast Tsunami Work Group, Community Leader Award for leadership in tsunami preparedness in the Big Lagoon Community and the Big Lagoon Rancheria (see Appendix J). This award is presented annually by the RCTWG to honor excellence in community leadership. As an active member of the RCTWG, I have also had the opportunity to network with the Earthquake Country Alliance (ECA), a statewide coalition whose mission is to promote earthquake and tsunami awareness and education, primarily through promoting the Great California Shakeout, a statewide earthquake drill held annually on the third Thursday of October. In September of 2011, I was given the honor of representing the RCTWG as a member of the ECA steering committee. In January 2012, I represented the RCTWG in Washington D.C. to accept the award given to the ECA by FEMA through the Champions of Change program for our success in promoting the Shakeout. Participation in the 2012 Shakeout exceeded 10 million people in California and is being expanded throughout the globe.

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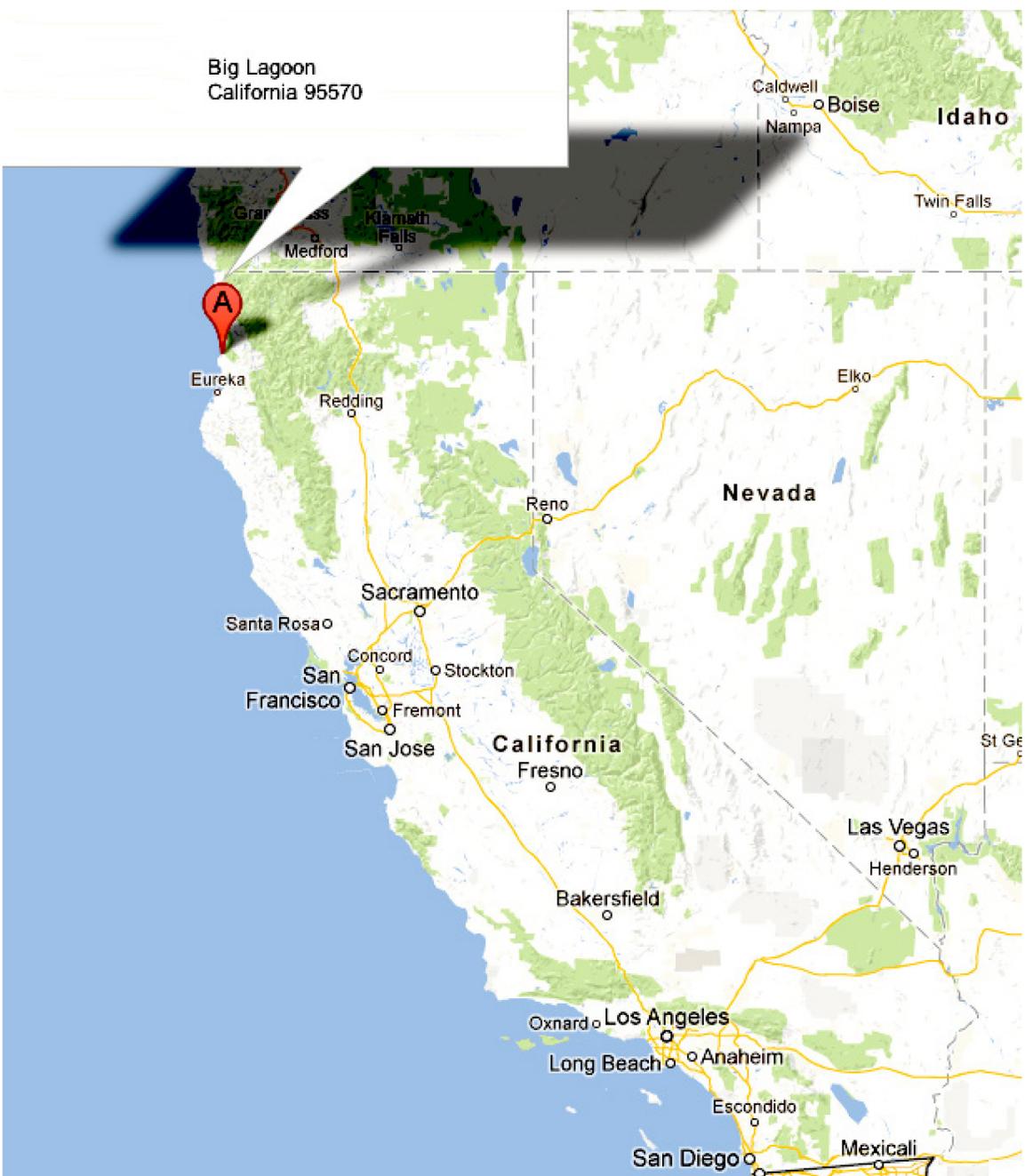
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APPENDICES

Appendix A. Location Map Big Lagoon



Source: Google Maps, 2012

Appendix B. *McKinleyville Press* Article, May 13, 2008

Photo by William Zoller

From left are Dr. Don Tuttle, Shane Harmon, Tom MacDonald, Xavier Morales, Kathleen Fairchild, Dr. Lori Dengler, Vicki Ozaki, Troy Nicolini and dog Lyla.

Big Lagoon prepares for tsunami

By Kathleen Fairchild
SPECIAL TO THE PRESS

Local tsunami experts, concerned community members and business people met at Big Lagoon on Tuesday, May 6, to walk the evacuation routes in the Big Lagoon community.

In attendance were Dr. Don Tuttle from the Big Lagoon Park Company; Shane Harmon, teacher from Big Lagoon School; Tom MacDonald, Green Diamond Resources Company; Xavier Morales, California State Parks; Kathleen Fairchild, HSU graduate student from the Environment and Community Program; Dr. Lori Dengler, HSU Geology professor; Vicki Ozaki, the National Park Service; Troy Nicolini, NOAA; and dog Lyla (who

has walked all the current planned tsunami evacuation routes in Humboldt County).

The walking of evacuation routes in a community is one of the first steps in preparing that community to become tsunami ready. Another important step is educating the community about the natural tsunami warning signs and were to go in an actual event.

Even though the State of California is currently installing highway tsunami signs, it is up to each community to take tsunami planning into its own hands through grass-roots efforts. The preparation at Big Lagoon community will continue with a community planning meeting and potluck on June 5 at 6 p.m. in the Big Lagoon School multi-purpose room. Further planning will continue with

simulated drills. The first drill will take place before the end of the school year in June, when Vickie, Troy and Shane and Kathleen will lead the children from a beach field trip back to the safety of the school.

Appendix C. Big Lagoon Rancheria Tsunami Information Pamphlet



hazard zone signs have been posted. Check the map on the reverse side to determine what areas are at risk and what areas are safe. **If you are in a safe area, stay where you are.**

HOW DO I KNOW IF AN EARTHQUAKE IS BIG ENOUGH TO CAUSE A TSUNAMI?

Protect yourself during the earthquake.

- If you are on the beach and feel an earthquake, no matter how small, immediately move inland or to high ground.
- In other low lying areas, **COUNT** how long the earthquake lasts. If you count 20 seconds or more of very strong ground shaking and are located in a tsunami hazard zone, evacuate as soon as it is safe to do so.

GO ON FOOT. Roads and bridges may be damaged by strong ground shaking. If your only evacuation route is blocked by downed power lines, carefully cross without touching the lines. If evacuation is impossible go to the upper floor of a tall building, or climb a tree — this should only be used as a last resort.

BE PREPARED

- Know the best evacuation route
- Walk your route – practice your route at night and in stormy weather
- Discuss emergency plans with family, coworkers and neighbors
- Consider how to evacuate pets – such as dogs on leashes and cats in crates
- Prearrange assistance from neighbors if you need help evacuating. Handicarts may be useful in helping to evacuate the injured, the elderly or small children who may need help
- Take first aid and CPR training. Learn more about disaster preparedness. Living on the fault line training can be arranged for a group of ten people or more by calling the Red Cross at 443-4321
- NOAA Weatherband radios are a useful alternative to a siren.

HUMBOLDT COUNTY'S TSUNAMI RISK

A tsunami is a series of waves or surges most commonly caused by an earthquake beneath the sea floor. Tsunamis can cause great loss of life and property damage where they come ashore.

- The first wave is almost never the largest
- Successive waves may be spaced ten or more minutes apart and continue arriving for many hours.

Two ways of knowing that a tsunami is coming:

Natural Warning

Strong ground shaking, a loud ocean roar, or the water receding unusually far exposing the sea floor, are all Nature's warnings that a tsunami may be coming. If you observe any of these natural warning signs, immediately move to higher ground or inland. Stay away from low areas until told by emergency personnel or informed by radio that the danger has passed. A tsunami may arrive within minutes of any of these natural warning signs and may last for 8 hours or longer.

Official Warning

You may be notified that a Tsunami Warning has been issued by: TV and radio stations (through the Emergency Alert System), door-to-door contact by emergency responders, NOAA weather radios, or in some cases, by outdoor siren. Move away from the beach and seek more information without using a phone. Tune into a local radio or television station for more information. Follow the directions of emergency personnel which may include evacuating low lying coastal areas.

Both Natural and Official warnings are equally important. Respond to whatever you hear or observe first!

What AREAS ARE AT RISK?

Beaches and low lying areas close to the coast such as lagoons, bays and river mouths are at greatest risk. In some areas, tsunami

TSUNAMI!

HOW TO SURVIVE THIS HAZARD AT BIG LAGOON*



* "Long ago, an old man lived at Pi'npa and another near at Oket'o on Big Lagoon. Then once as people looked out over the ocean, they saw it stood high, like the hills, and all were afraid." Yurok Oral History

IF YOU FEEL A STRONG EARTHQUAKE:

- Protect yourself during strong ground shaking. Drop, cover and hold.
- Move to higher ground or inland as soon as it is safe to do so

A tsunami may be coming

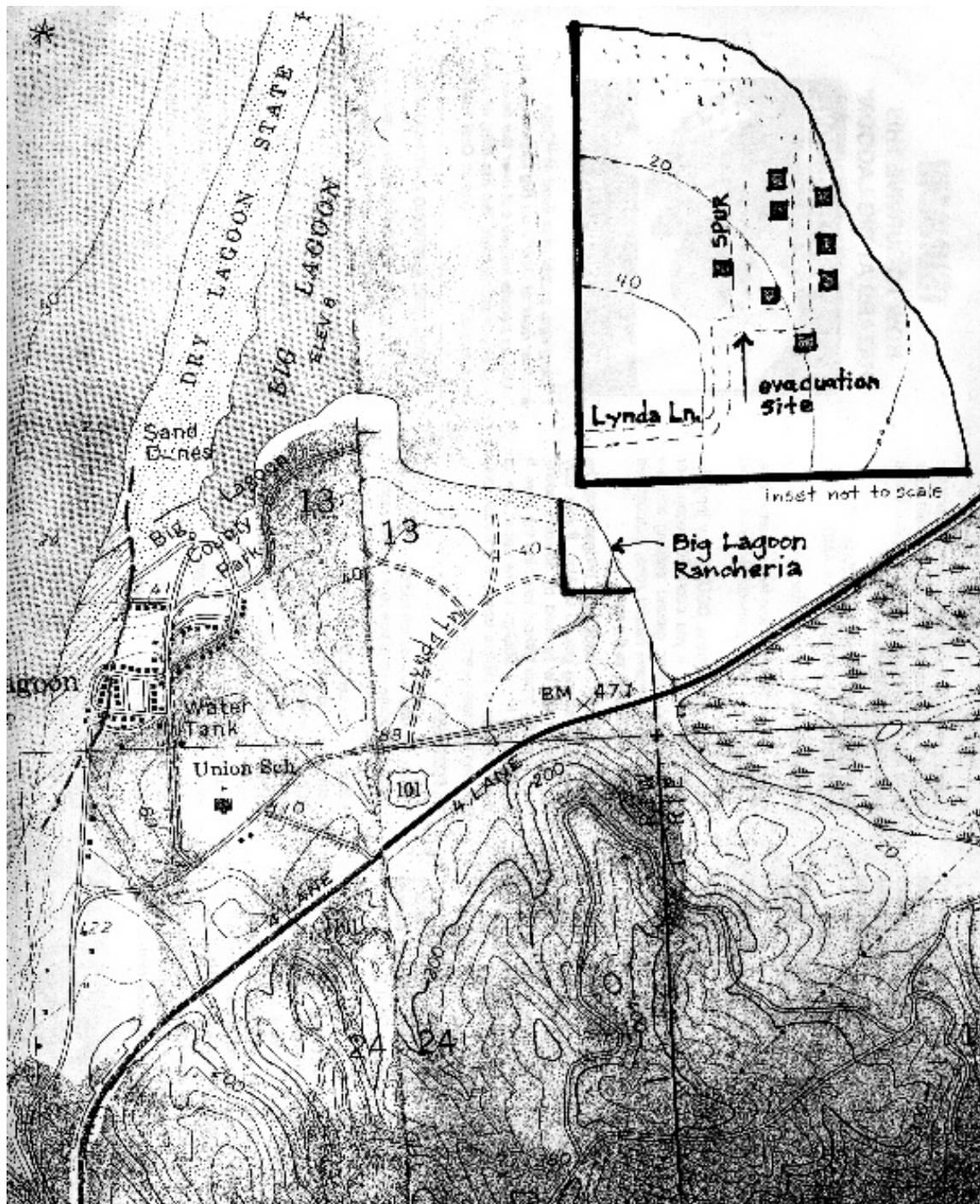
DO NOT WAIT FOR AN OFFICIAL WARNING

- Stay away from the coast. Waves may continue to arrive for 8 hours or longer
- Do not leave high ground before an official "all clear"

Listen to a radio for information

Prepared by: Humboldt Earthquake Education Center, Humboldt State University for educational purposes only. ©Jan. 2008. *Adapted for Big Lagoon by K.Franchild Sept. '08

Appendix D. Big Lagoon Rancheria Tsunami Information Pamphlet Map



USGS 1978 Topographic map, Trinidad Quadrangle California-Humboldt Co 7.5 minute series, modified by Kathleen Sullivan Fairchild, 2008

Appendix E. First Tsunami Drill



Photo by William Zoller

Appendix F. TsunamiReady Website Worksheet

TsunamiReady Guidelines

Guidelines for being designated TsunamiReady are given in the following table. Each guideline is fully discussed following the table. The guidelines are based on four population-based categories.

Guidelines	Population			
	< 2,500	2,500 - 14,999	15,000 - 40,000	> 40,000
Guideline 1: Communications and Coordination				
Established 24-hour Warning Point (WP)	X*	X*	X	X
Established Emergency Operations Center (EOC)	X*	X*	X	X
Guideline 2: Tsunami Warning Reception				
Number of ways for EOC/WP to receive NWS tsunami messages. (If in range, one must be NWR receiver with tone alert; NWR-SAME is preferred)	3	4	4	4
Guideline 3: Local Warning Dissemination				
Number of ways EOC/WP can disseminate warnings to public	1	2	3	4
NWR - SAME receivers in public facilities	X	X	X	X
For county/borough warning points, county/borough communication network that ensures information flow among communities	X	X	X	X
Guideline 4: Community Preparedness				
Number of annual tsunami awareness programs	1	2	3	4
Designate/establish tsunami shelter/area in safe zone	X	X	X	X
Designate tsunami evacuation areas and evacuation routes, and install evacuation route signs	X	X	X	X
Provide written, locally specific, tsunami hazard response material to public	X	X	X	X
Schools: Encourage tsunami hazard curriculum, practice evacuations (if in hazard zone), and provide safety material to staff and students.	X	X	X	X
Guideline 5: Administrative				
Formal tsunami hazard operations plan	X	X	X	X
Biennial meeting between emergency manager and NWS	X	X	X	X
Visit by NWS official to community at least every other year	X	X	X	X

* For cities or towns with less than 15,000 people, a 24-hour warning point and EOC are required; however, another jurisdiction within the county may provide that resource.

Source: <http://www.tsunamiready.noaa.gov>

Appendix G. TsunamiReady Dedication Announcement



TsunamiReady Dedication
Big Lagoon, California, March 26, 2010, 12:30 pm

The Community of Big Lagoon is now TsunamiReady!

Please join us in this Celebration at Big Lagoon School

- Residents, Teachers & Students of the Big Lagoon Community have worked hard to become TsunamiReady*
- TsunamiReady Communities are better prepared to save lives through better planning, education and awareness.
- The ceremony will be hosted by Nancy Dean, Director, National Weather Service, Eureka with special guest Jim Goltz, Earthquake and Tsunami Program Manager at California Emergency Management Agency (Cal EMA), Organized by Kathleen Fairchild, HSU Graduate Student, Environment & Community Program

*TsunamiReady is a trademark of the National Weather Service
www.tsunamiready.noaa.gov

Photo & Design: WZoller'10

Flyer and photo by William Zoller

Appendix H. TsunamiReady Dedication, March 26, 2010: Tsunami Cake



Photo by William Zoller

Appendix I. *Times-Standard* Article, February 16, 2010

Big Lagoon community is tsunami-ready

Times-Standard

Posted: 02/16/2010 01:14:14 PM PST

Photo credit: Nancy Dean, National Weather Service

People weren't kidding when they said it will be the children who save us all. The children of the Big Lagoon Rancheria proved that they had learned the natural hazard warning signs of a potential tsunami when the North Coast rattled with a 6.5 magnitude earthquake on Jan. 9. Following the children's example, the community took appropriate action to avoid a potential tsunami. Big Lagoon Rancheria has been participating in annual tsunami evacuation drills since 2008, most recently on Oct. 17, 2009, pictured above. Two sets of parents, including Rancheria Environmental Specialist Roger Lara and his wife, Mindy, decided to observe the October drill to see if the children would respond appropriately. The children did just as they had been instructed with the older children helping the younger children to higher ground. A ceremony to officially declare Big Lagoon a TsunamiReady Community will be held at Big Lagoon School on March 26.



Times-Standard 2010, February 16. *Big Lagoon community is tsunami-ready*

Appendix J. RCTWG Community Leader Award Photo



Photo by William Zoller