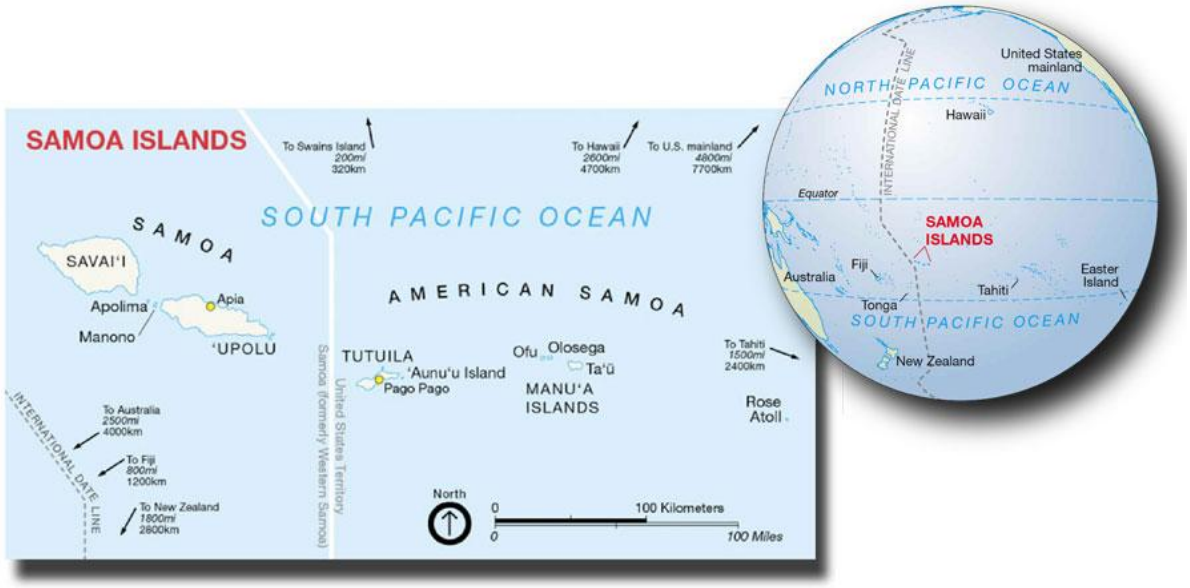
"Sustainable Mangroves for Resilience in American Samoa"

American Samoa is an unincorporated island territory of the United States in the southern Pacific Ocean, the only piece of US land located south of the equator. Although geographically part of the United States, American Samoa's population of about 55,000 people faces unique social, economic, and environmental challenges. The population of the island territory has doubled over the past 45 years (CIA, 2015). This growth led to a sharp increase in development, especially along the coast where land is flatter compared to the steep inland. Mangroves in American Samoa, saline-tolerant coastal forests, have faced significant degradation from clear cutting and pollution from the rising development. This project, *Sustainable Mangroves for Resilience*, aims to restore these mangroves to preserve the ecological services they provide. The technical dimensions of ecological restoration are currently underway through the American Samoa Community College Forestry Program, the key partnership that forms this project proposal; a grant from the Phadke Foundation will fund the educational and outreach sector of the project. The *Sustainable Mangroves for Resilience* project falls primarily under the issue area of environmental conservation, as it will restore and maintain native plant species and critical wildlife habitat, and will replenish historical fishing yields. This project views sustainable development through a lens of resilience. Mangrove restoration will conserve biodiversity to build sustainable subsistence and economic resilience; the trees will protect the human and infrastructural capital of American Samoa, building resilience in the face of climate change and future extreme weather events.



Map of American Samoa (Jaffe, 2009). Accessed from: http://soundwaves.usgs.gov/2009/12 on 6 May 2015.

The Society:

The first European contact with what is now American Samoa was in 1787 when French sailors landed there. It resulted in a violent conflict and the death of 12 French and 39 Samoans before the French retreated (McKinnon et al., 2009). Some forty years later, in 1830, British missionaries arrived and permanently established a European presence. In the latter half of the nineteenth century negotiations between Britain, Germany, and the United States determined that the eastern islands of the Samoan Islands would be taken over by the US through a 'deed of cession,' an agreement signed by all local chiefs (McKinnon et al. 2009). The islands became a protectorate of the US, meaning that the traditional culture of the Samoans would be maintained, and a US naval station was established. For more than half a century the now *American* Samoans were able to maintain their traditional social structure and a subsistence economy, but in the 1960s the Kennedy Administration modernized the islands; American-style houses replaced their thatched-roof and open-sided homes, electricity infrastructure was installed, the Pago Pago international airport was built, and the tuna canning industry opened (McKinnon et al., 2009).

Despite their governance by the United States, American Samoans are not born US citizens. They are considered 'nationals,' the status granted to them in 1900, unless they pursue the arduous and expensive naturalization process to gain citizenship. This means that they cannot vote in national elections and cannot hold jobs that require citizenship (Cevallos, 2014). However, they can serve in the US military, and do so in large numbers – the territory has the highest rate of enlistment of all states and territories (Cevallos, 2014). Joining the military service is a popular option for many of American Samoa's young men and women who seek better economic opportunities and higher education. About half of the island's population lives below US poverty levels (Potter, 2006), and the only higher-level education institution is the two-year American Samoa Community College (ASCC).

Today their geographic isolation allows American Samoa to maintain their traditional culture (88.6% of the residents speak Samoan) while also fully engaging in the globalized world of trade, relying on imports for nearly all of their food and fuel sources (CIA, 2015). Despite facing the residual challenges of colonialism, it is unlikely that the territory will attempt to gain full independence. The islands receive significant amounts of money, infrastructure, stable governance, and other benefits from being a part of the United States and "American Samoans are loyal to the US," (McKinnon et al., 2009, 339). However, this loyalty should not be taken for granted; American Samoa's geographic isolation and limited natural resources contribute to economic and environmental vulnerabilities and this grant will help build resilience in a far-off US territory that faces challenges unlike anywhere else in the United States.

The Economy:

Since the 1960s American Samoans have shifted away from subsistence and now rely heavily on trade for their livelihoods. The primary economic activity is catching and canning of tuna. Two canneries employ 80% of the labor force and tuna accounts for 93% of exports (CIA, 2015). The physical geography of the islands contributes to the lack of economic diversity. The volcanically formed islands have steep terrain with limited coastal plains and only 15% of the land is arable (CIA, 2015). There are no local nonrenewable energy sources and currently no infrastructure for renewables; all energy comes from imported oil and the remote location leads to power outages. Finally, the regular occurrence of natural disasters reduces the resilience of

social and infrastructural capital. The *Sustainable Mangroves for Resilience* project will protect the current capital from destruction and will contribute to increased ecological services.

The Environment:

Fisheries

A study conducted in 2013 by Levine and Sauafea-Le'au interviewed "elder" fishermen (between ages 40-86 with the median age at 62 years old) in American Samoa, and determined that over the past 25 to 50 years there has been a palpable decline in fish yields. A declining coastal habitat due to pollution and encroaching development was the number one reason cited for the declining yields (Levine & Sauafea-Le'au, 2013). This shrinking fish population has significant implications for those fishermen who rely on fishing for subsistence and extra income. Because fish are a vital aspect of American Samoan tradition, especially the communal sharing of a catch, (Levine & Sauafea-Le'au, 2013) restoring and maintaining the fish population is vital to cultural maintenance on the island, especially as it continues to rely on the world beyond its borders for resources. The *Sustainable Mangroves for Resilience* project will rebuild critical fish habitat and preserve this habitat into the future.

Volatile Climate

American Samoa regularly faces extreme weather events and is experiencing the impacts of climate change. Between 1985 and 2015 (data available 1950-2015), there were 5 cyclones, 23 flash floods, 6 hurricanes, and 5 tsunamis. All of the tsunamis occurred between 2006 and 2011 and all hurricanes between 1998 and 2011, indicating the increasing regularity of severe weather and a changing climate (NOAA, 2015). Cyclone Tusi, one of the worst storms in history, hit the island in 1987.

In 2009, American Samoa experienced an 8.3 magnitude earthquake followed by a tsunami, resulting in the deaths of 32 people and the loss of 200 homes and businesses (USACE, 2012). American Samoa lies close to one of the world's most active fault lines, the Tonga Trench (USACE, 2012), meaning that earthquakes and ensuing tsunamis are an inevitable occurrence, and one that may be increasing as the global climate becomes more volatile with climate change. Mangroves, coastal wetland trees, can act as a natural barrier to tsunami damage but in American Samoa these trees have faced significant degradation; restoring the mangroves is the number one priority of the *Sustainable Mangroves for Resilience* project.

Mangroves

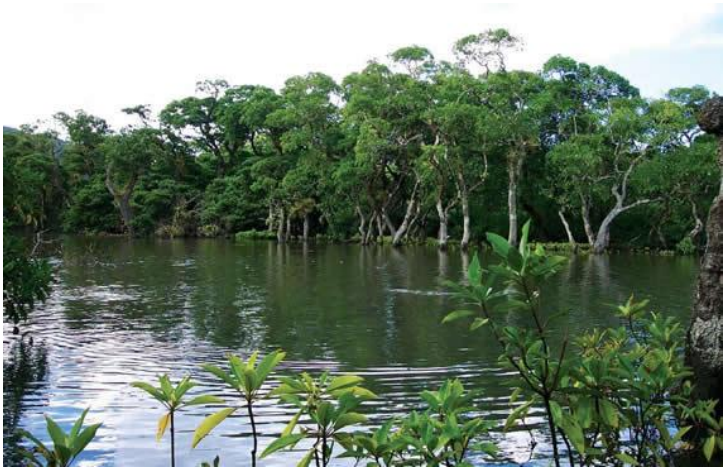
Mangroves are trees found along tropical shorelines that stand in the shallow waters of the ocean. They are saline-tolerant and have roots that can hold themselves up in soft mud. Their seeds float and disperse through water to reproduce. Mangrove roots stabilize and reinforce shorelines (Lewis, 2004) and it has been shown that mangroves can play an important role in acting as a barrier to coastal inundation, absorbing the initial pressures of incoming waves and reducing the energy impact (Alongi, 2008; Lewis, 2004).

A report published by the Forestry Program at American Samoa Community College (ASCC), the key partner in this project, has documented the loss of mangroves around the islands and has designed restoration plans. In American Samoa, mangroves are found on Tutuila, the largest island and home to the majority of the population, and Aunu'u (Forestry Program, 2010). Maintaining coastal habitats and acting as a shield in natural disasters are the two primary functions of mangroves in American Samoa. The ASCC forestry report (2010) utilized GIS analysis to determine that mangroves are a "high value conservation area" for their creation of critical habitats of native species and for their flood mitigating properties. The American Samoa mangroves have seen a significant decline over the past 25 years:

Mangrove Loss in American Samoa	
YEAR	ACRES
1988	148
2003	122
2009	89

Adapted from: American Samoa Community College Forestry Program "Forest Assessment and Resource Strategy" (2010).

As mentioned previously, most of the land on American Samoa is steep and so development is heavily concentrated on the limited coastal plains. Mangroves have been cleared and filled in to make more space for buildings and some have turned into trash dumping grounds (Forestry Program, 2010). As the mangroves have disappeared, flooding has become more frequent and fishing yields have declined (Forestry Program, 2010; Gilman and Ellison, 2007; Levine and Saufafea-Le'au, 2013).



Mangroves in the southern Pacific Ocean (A World to Win, 2006). Accessed from: http://www.aworldtowin.net/resources/ccmangroves.html on 6 May 2015.

Restoration of mangroves has been estimated to cost between $225/hectare to $216,000/hectare (Lewis, 2001). This huge range comes from the infinite potential variables that may need to be addressed in the restoration process. There are two options for mangrove restoration: growing saplings in a nursery and replanting them into the coastal ground or self-restoration through mangrove clean up and natural re-seeding (Lewis, 2004). The latter is the preferred method because it is significantly cheaper and eliminates some degree of human error in planting. Regardless of the method, restoring the natural hydrology of a mangrove is the most crucial first step. Depending on the degree of hydrological disruption in the mangrove area, the amount of soil to be excavated or brought in will significantly affect the cost of a restoration

project (Lewis, 2004). Finally, there is variation in the reasons why mangroves become degraded in the first place and so it is vital to identify and intervene in destructive practices.

The primary area of concern for mangrove conservation and restoration in American Samoa is on the southern side of Tutuila, the main island, in the villages of Leone and Nu'uuli (Forestry Program, 2010). The Forestry Program at ASCC began the restoration project from a participatory development foundation. The community mayors, village council, coastal fishermen, and property owners adjacent to the potential mangrove restoration sites were asked for official permission to conduct the research and designs for the project, and the project was unanimously approved.

In 2013 ASCC contracted hydrologists from the US Department of Natural Resources to examine the degraded mangroves in these villages and to determine the extent to which hydrology would need to be manipulated for restoration. Their findings indicated that a moderate amount of hydrological restoration would be necessary due to the clearing and filling in of the mangroves, and that the plating of saplings method would be appropriate because the few remaining trees were not suited to self-restoration through seeds. These two findings significantly raised the costs involved in restoration: $300,000 in total, which is being funded through other grants and minimal aid from the US Department of Resources. Staff of the Forestry Program conducted a study to determine the root causes of the previous mangrove's degradation and found that human-induced clearing and pollution were primarily responsible, the most-often cited reasons for mangrove deterioration.

The Solution:

The technical framework and project plan for reforesting the coasts of Leone and Nu'uuli villages is already set in motion. The ASCC Forestry Program is in the process of planting new saplings and will be responsible for monitoring and measuring the success of these trees. The Phadke Foundation grant will fund the necessary broader community involvement and support of the *Sustainable Mangroves for Resilience* project that will ensure the new mangroves do not face further pollution or degradation. Considering the amount of money that is going into rebuilding the mangroves on Tutuila, it is important that degradation of the restored mangroves be avoided; the long-term sustainability of the mangroves is crucial to avoid further lost money and resources.

The piece that is missing in the Forestry Program's restoration process is educating the community on how to successfully conserve the mangroves into the future. Building a community-based conservation ethic will be integral in minimizing negative human impacts on mangroves (Gilman & Ellison, 2007). Once this ethic is defined, the *Sustainable Mangroves for Resilience* project will educate and involve the communities in fostering the growth and health of the mangroves.

Partnerships:

The primary partner of the *Sustainable Mangroves for Resilience* project is the Forestry Program, part of the Division of Community and Natural Resources at the American Samoa Community College. The Forestry Program will be responsible for the technical aspects of the ecological restoration process. Their work attempts to:

1. Conserve sustainable urban forests and their numerous benefits

2. Protect coral reefs through the implementation of appropriate terrestrial management practices and
3. Maintain fresh water quality with effective forest management practices

Mangrove Action Project (MAP) is a US, Indonesian, and Thailand-based organization that takes a bottom-up approach to mangrove restoration and conservation. They partner with NGOs and governments in the global South to fund mangrove projects through education, art, advocacy, research, and campaigns. The *Sustainable Mangroves for Resilience* project will partner with them to bring mangrove education into the primary and secondary schools of American Samoa (Mangrove Action Project, 2015).

Key Player Qualifications:

Shelby Maidl is a young professional with a Bachelors degree from Macalester College in Geography and Environmental Studies. She has experience in environmental advocacy and outreach, environmental/outdoor education, and communications. Her background has prepared her to be the Outreach and Education Manager in the *Sustainable Mangroves for Resilience* project. She will be the primary contact for the village residents and will be responsible for organizing and implementing all community events.

Mary Taufete'e has been the senior State Forester at American Samoa Community College for the past four years and has been in charge of the Forestry Program. Previous to this she worked as an instructor at the College and served as a member of the American Samoa House of Representatives for nine years (information taken from Mary Taufete'e's LinkedIn profile). Her role in the *Sustainable Mangroves for Resilience* Project will be Project Coordinator. She will coordinate between the technical and educational aspects of the mangrove restoration, connecting the work of the Forestry Program with the education and outreach initiatives.

Actions and Objectives:

The *Sustainable Mangroves for Resilience* project, in coordination with the ASCC Forestry Program reforestation project, will restore American Samoa's mangroves in the Leone and Nu'uuli villages on the southern coast of Tutuila (populations of about 1500 and 4500 respectively). Mangrove restoration will aim to strengthen the resilience of the communities through the following actions:

1. **Hold open forum community meetings in each village to collectively determine a firm definition of the local conservation ethic**
2. **Outreach in order to educate the communities about the natural benefits that mangroves provide, the ways in which mangroves become degraded, and how individual and group actions can prevent this degradation in the future**
    a. **School curriculum**
    b. **Community fairs**
    c. **Presentations to institutions, community spaces, and employment spaces**

3. **Recruit and train a volunteer corps to monitor the health of mangroves and do regular pollution cleanups**
4. Restoring the hydrology and replanting mangroves of Leone and Nu'uuli villages (*Forestry Program*)

The intended outcomes of this project include:

1. **Define a community conservation ethic**
2. **Improve understanding and concern for mangroves at all age levels and in all institutions and community spaces**
3. **Create a volunteer corps that regularly cleans up the mangroves**
4. Conserve local biodiversity and native species; build resilience of coastlines to extreme weather events and climate change, in order to protect and prevent loss of social and infrastructural capital; restore critical fish habitat in order to replenish historical fish yields for subsistence and cultural purposes (*Forestry Program*)

Measurement of Achievement:

1. **Firm, documented, and community-authorized definitions of a conservation ethic in each village, to be displayed in the main office of the Forestry Program at American Samoa Community College**
2. **Test scores of students will reflect the degree to which technical understanding of mangroves has changed in youth**
3. **Conduct village-wide and school-wide surveys at the end of each year to gauge the degree to which understanding and concern for mangroves has changed due to education and outreach, and to identify areas for improvement**
4. **Have an established volunteer corps after one year, of at least 10 members in Lenore and 25 members in Nu'uuli, who organize themselves to cleanup the mangroves at least every 4 months**
5. The Forestry Program will be responsible for monitoring the ecological health of the mangroves and measuring the rates of survival of trees, fish yields, and mitigating impact of mangroves during extreme weather

Timeline (August 2015 – August 2017) 2-year project

August 2015 – December 2015

We will acquire and distribute Mangrove Action Project's 300-page proven Marvelous Mangroves curriculum guide which, with insights from the open forum community discussions and from the ASCC Forestry Program staff, can be tailored to include American Samoa's unique ecology and culture, and be translated into Samoan in order to reach the largest audience possible. Teachers in the schools will go through a series of intensive workshops and hands-on learning to become experts on the functions of local mangroves and the threats they face. This training is designed for integration into the national curriculum in order to ensure that mangroves are part of every child's schooling into the future. The Marvelous Mangroves curriculum also incorporates fieldtrips to foster participation in conservation among the youth.

August 2015 – September 2015

Two months will be spent designing and preparing outreach and education materials for adults in Leone and Nu'uuli villages. This time will also be used to gather contacts and make connections and to begin planning presentations for village institutions, community spaces, and employment spaces. Shelby Maidl, a graduate of Macalester College who has experience in community outreach, creation of education materials, and experiential teaching will do this work.

October 2015 – October 2016

Twelve months will be dedicated to conducting the first round of outreach and education, attempting to reach about 500 residents per month (6000 residents total between the two villages). During this year a firm definition of each village's conservation ethic will be reached. At the end of this first year, a survey will be conducted to determine the degree of impact of the presentations, community fairs, and implementation of curriculum.

November 2016 – December 2017

The second year of this program will use the feedback gathered from the villages to modify, expand, create, and implement more nuanced outreach and education with the intention of recruiting and training a volunteer corps. Staff of the Forestry Program, who are experts at mangrove conservation, will train these volunteers on mangrove health indicators and ways to clean them up. During this first year of the volunteer corps, the program will aim for volunteers to organize and complete 2 cleanups of the mangroves.

Looking to the future:

The *Sustainable Mangroves for Resilience* project will educate and train the community members of Leone and Nu'uuli to become leaders in the restoration and conservation of mangroves. Future funding of this project will hopefully allow these community members to more directly invest in the mangroves and place a lesser emphasis on education and outreach because the community should be well versed by the end of the first two years of this project. This grant will build the foundation of the *Sustainable Mangroves for Resilience* project in order to avoid more restoration funding and to provide for a healthy and successful future of mangroves in American Samoa.

Budget:

The costs listed in the table reflect the large disparity between the average per capita income in the US with that of American Samoa, $26,695 and $6,311 respectively. Per capita income in the US is about 4.3 times more than that of American Samoa. The numbers in this table were determined by estimating costs in regular USD and then dividing by 4.3, and rounding. The total grant proposal asks for $44,180.00.

Item		**Total cost in USD during project**
Marvelous Mangroves curriculum and teacher training	$0 (funded by US Dept. of Natural Resources Environmental Education grant)	$0
Salary of Shelby Maidl	$6000 x2 years	$12000
Salary of Mary Taufete'e	$9000 x2 years	$18000
Travel	$7000 (one round-trip airfare for Shelby from MSP to Pago Pago)	$7000
Community meetings	$60 per meeting x8 per year x2 years	$960
Community fairs	$235 per fair x6 per year x2 years	$2820
Outreach materials	$1700 x2 years	$3400
Total		**$44,180.00**

Works Cited:

A World to Win. (2006). Climate change threatens Pacific Ocean mangroves. *A World to Win*. Retrieved from: http://www.aworldtowin.net/resources/ccmangroves.html

Alongi, D.M. (2008). Mangrove forests: Resilience protection from tsunamis, and responses to climate change. *Mangrove Science Database*. Retrieved from: http://mangroves.elaw.org/node/60

Cevallos, D. (2014). Should American Samoans be citizens? *CNN*. Retrieved from: http://www.cnn.com/2014/02/11/opinion/cevallos-citizenship-american-samoa/.

CIA. (2015). The world factbook: American Samoa. Retrieved from: https://www.cia.gov/library/publications/the-world-factbook/geos/aq.html.

Forestry Program. (2010). American Samoa forest assessment and resource strategy. *American Samoa Community College*. Retrieved from: http://www.wflccenter.org/islandforestry/americansamoa.pdf

Gilman, E. and J, Ellison. (2007). Efficacy of alternative low-cost approaches to mangrove restoration, American Samoa. *Coastal and Estuarine Research Federation, 30*(4). http://www.americansamoarenewal.org/sites/default/files/resource_documents/ASTS_Final_Report-031312.pdf

Jaffe, B. (2009). Surprises from the deadly September 29, 2009, Samoa tsunami. *USGS*. Retrieved from: http://soundwaves.usgs.gov/2009/12/

Levine, A. and Saufafea-Le'au, F. (2013). Traditional knowledge, use, and management of living marine resources in American Samoa: Documenting changes over time through interviews with elder fishers. *Pacific Science, 67*(3).

Lewis, R. R. (2001). Mangrove restoration – Costs and benefits of successful ecological restoration. *Beijer International Institute of Ecological Economics*. Retrieved from: http://www.fao.org/forestry/10560-0fe87b898806287615fceb95a76f613cf.pdf

Lewis, R.R. (2004). Ecological engineering for successful management and restoration of mangrove forests. *Ecological Engineering, 24*(4).

Mangrove Action Project. (2015). Education. *Mangrove Action Project.* Retrieved from: http://mangroveactionproject.org/
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McKinnon, R., Atkinson, B., Brash, C., Carillet, J., Dragicevich, P., Harewood, J., Luckham, N., McLachlan, C., Starnes, D. (2009). *South Pacific*. Lonely Planet, 4th Edition.

NOAA. (2015). Storm events database. *National Climatic Data Center*. Retrieved from: http://www.ncdc.noaa.gov/stormevents/

Potter, M. (2006). Eager to serve in American Samoa. *NBC*. Retrieved from: http://www.nbcnews.com/id/11537737/ns/nbc_nightly_news_with_brian_williams/t/eager-serve-american-samoa/#.VT6m4GRVikp

Sagapolutele, F. (2012). Village census count released with some adjustments; total count remains the same. *Samoa News*. Retrieved from: http://www.samoanews.com/content/village-census-count-released-some-adjustments-total-count-remains-same

USACE. (2012). Final report: American Samoa tsunami study. *USACE*. Retrieved from: http://www.americansamoarenewal.org/sites/default/files/resource_documents/ASTS_Final_Report-031312.pdf