

THE UNIVERSITY OF HAWAI'I AT HILO  
MARINE OPTION PROGRAM

A Quick Guide to Maintaining a Healthy Coral Reef Ecosystem in Hawai'i: An  
informative pamphlet for public education and outreach

DURATION

January 2013- Spring 2015

PROJECT LEADER

Jenna Rubin  
Marine Science Department  
University of Hawai'i at Hilo

ADVISORS

Steven Colbert- UH Hilo MOP Instructor  
Patrick Rynne- Creative Director, Waterlust  
Jannah Caster-Marketing Director, Waterlust

Marine Science Department  
University of Hawai'i at Hilo

PROPOSAL DATE

August 2014

FINAL REPORT DEADLINE

Spring 2015

## ABSTRACT

Coral reefs are one of the most important ecosystems of the ocean because they provide food, habitat, and shelter for thousands of species. Large coral reefs attract many visitors which provides the tour industry with a large source of income. In Hawai'i alone, tourism associated to reefs is a multi-million dollar industry. Healthy reef systems are what attract tourists to specific locations. Tourism also has crucial impacts on the health of these ecosystems. Many travelers are unaware of how important coral reefs are for the ocean and that coral itself is a living organism. It is important to educate the travelers in order to ensure an eco-friendly visit to Hawai'i. Using photographic techniques aided by brief facts and actionable recommendations organized in Adobe Illustrator I created a double-sided, tri-fold pamphlet constructed out of 100% recycled and eco-friendly products to distribute to local tour companies, dive shops and hotels. This project was intended to educate the tourism community in Hawai'i about Hawaiian coral reef ecosystems and how they are currently being threatened by human impacts. Many travelers are also unaware of the endangered marine life that use Hawai'i's coastal areas as their habitat such as Hawaiian Green Sea Turtles (*Chelonia mydas*) and common marine mammals found in Hawai'i. I have also included panels in this pamphlet that educate the reader by answering frequently asked questions regarding these organisms. . I incorporated brief, but important facts about marine life in Hawai'i and what people can do to promote and maintain healthy reef systems, as well advice to minimize any negative impacts that tourism may have on our local species. I collaborated with Waterlust, an ocean conservation outreach organization, for the both the design and printing processes. This project is aimed to attract and entertain tourists using photography, as well as bring a new appreciation for the beauty of coral reefs. Engaging the reader with photography, education, and actionable advice, this this pamphlet will reduce the tourist impact Hawai'i's marine life.

## INTRODUCTION

The ocean covers 71% of Earth's surface and our coral reef ecosystems make up a small 1% of the ocean's floor, yet they are home to an estimated one million species. 25% of the ocean's inhabitants occupy coral reef ecosystems (NOAA 2014). These ecosystems contain a variety of habitats, exhibit high environmental heterogeneity, and harbor highly complex biological and ecological processes (Alva-Basurto 2014). This minute portion of the world's oceans is struggling to maintain this small percentage of coverage. Coral reef resources are being depleted due to many reasons that are caused by both anthropogenic and natural stressors. Coral reef ecosystems are one the most diverse and productive biological ecosystems on earth, but have been degrading over the past 2-3 decades at an alarming rate throughout the world (Rinkevich 2005).

Reefs all over the world are being affected by ocean acidification, global warming, and direct human contact. Currently, 30% of coral reefs are estimated to be damaged. If habits continue, it is assumed that as much as 60% of coral reefs will be damaged by 2030 (Liman 2014). If human habits persist and increase the rate of global warming, corals could be in serious danger of extinction. Global climate change and local anthropogenic pressures are among the primary factors leading to the decline of functional biodiversity and critical habitats in coral reefs (Doiron 2014). Unfortunately, humans are the source of this pollution. The increased temperatures and decreased dissolved oxygen and pH levels associated with pollution, coastal development (land-use change), and fisheries are alarmingly impacting reef ecosystems (Nyström et al. 2008; Madin et al. 2012). In order to thrive, a coral colony must have sunlight, nutrients, and a water temperature range of 73-84 degrees Fahrenheit (NOAA). Air and water pollution have a large effect on these factors, which is then reflected upon the overall coral reef health (Alva-Basurto 2014).

Coral bleaching occurs when the symbiotic relationship between algae (zooxanthellae) and the host coral breaks down under certain environmental stresses (Baker et al. 2008). As a result, the host expels its zooxanthellae, consequently exposing its white calcium carbonate skeleton, and the affected coral colony becomes stark white or pale in color (T.D. Ainsworth et al. 2011). Coral disease outbreaks are now recognized as a significant factor in the accelerating degradation of coral reefs, and it is commonly assumed that a variety of human-related activities have altered environmental conditions, potentially impairing coral resistance to microbial infections or increasing pathogen virulence (Altizer et al. 2013). Anthropogenic activities implicated in disease outbreaks and rising prevalence levels (i.e., the number of cases of a disease in a given population at a specific time) include proximity to human population centers (Aeby et al. 2011a), coastal land alteration and dredging (Guilherme Becker et al. 2013; Pollock et al. 2014), terrestrial runoff of sediment or agricultural herbicides (Owen et al. 2002; Haapkylä et al. 2011), sewage outfalls containing human enteric microorganisms (Patterson et al. 2002), increases in nutrient concentrations (Bruno et al. 2003), aquaculture and fish farms (Harvell et al. 1999; Garren et al. 2009), a reduction in the diversity of reef fish assemblages (Raymundo et al. 2009), and sunscreens (Danovaro et al. 2008). Coral bleaching can be triggered and sustained under various environmental stresses.

Not only are some corals important because of the life they provide, they are also important in an economical-sense. Dive tours, fishing, hotels and restaurants, and other businesses based near reef systems provide millions of jobs and contribute billions of dollars all over the world. Coral reef-based tourism is one of the fastest growing tourism sectors worldwide (Ong and Musa 2011). In Hawai'i alone, tourism connected to reefs attracted an estimated 6.7 million visitors and generated \$11.4 billion in 2004 (Sun 2014). Evaluation of the tourism carbon footprint has gained prominent attention in recent years as a means to account for the environmental externality of tourism growth (Sun 2014). Most visitors are unaware of the vulnerability of coral reefs and how everyday routines are threatening the coral reef ecosystems. Stepping, standing, kicking, and touching coral will harm the living animal and potentially kill it. Killing coral is not only killing thousands of polyps, but it is also killing the home for several species of fishes and

invertebrates. Until recently, recreational reef-based activities, such as diving and snorkeling, were thought to have little direct impact on coral assemblages. However, over the past two decades, numerous studies have been conducted on the physical impacts and management of diving on coral reefs worldwide. Most concluded that diving could adversely affect coral assemblages through physical injury (Hawkins and Roberts 2002). Damage associated with intensive recreational tourist use has been documented extensively on coral reefs, however other impacts on coral health are unknown (Lamb 2014). Coral bleaching has negative impacts on biodiversity and functioning of reef ecosystems and their production of goods and services. Recent studies have shown that personal care products, including sunscreens, have an impact on aquatic organisms. Every year, between 4000-6000 metric tons of sunscreen washes off swimmers and snorkelers into the coral reef environments (Danovaro 2008). The release of sunscreen products is also linked with the rapid expansion of tourism in marine coastal areas (Wilkinson 2004). Chemical compounds contained in sunscreens and other personal care products have been demonstrated to reach detectable levels in both fresh and sea-water systems (Giokas et al. 2007). These compounds are expected to be potentially harmful for the environment. Global decline in coral reef health is a critical conservation concern, especially for the estimated 275 million people that live within 30 km of coral reefs and draw extensively on them for livelihood and food security (Bellwood et al. 2004). Tourism is generally considered a favorable alternative, typically providing an incentive to preserve natural areas, thereby contributing to environmental protection, sustainable use practices, and the restoration of biological diversity (Buckley 2012). However, because the majority of coral reefs are located in developing and often undermanaged island and coastal regions (Donner and Portere 2007), the unrestricted growth and rapid development of reef-based tourism often undermines the conservation priorities necessary to sustain it.

Hawaii's coral reefs bring in millions of visitors who are not all aware of the struggling ecosystem. It is important to inform these travelers of the importance of Hawaii's reefs and how the reef systems are currently suffering from our own doing. Much of the public mistakes coral reef structures as rock or other nonliving material. Contrary, these underwater structures are full of life. Many tourists are not aware of the biological or ecological functions of coral reefs. Yes, the reefs are a main attraction for travelers visiting the Hawaiian Islands, but most do not know the direct affect they have on coral reefs. Before one can understand *how* to reduce their impact on the ocean and its critters, one must understand *why*. To help people minimize their impact while enjoying their visit to Hawai'i, I designed a tri-fold, double-sided pamphlet that informs and entertains the reader about the biology and ecology of Hawai'i's marine life and leaves them with four simple pieces of advice. I have included panels in the pamphlet focusing on the biology and ecology of coral reefs, Hawaiian Green Sea turtles and common marine mammals found in Hawaii. These panels are aimed to educate the traveler about marine organisms that they will likely encounter on their visit to Hawaii.

## Objectives

1. Assess the needs of local dive shops, hotels and tour companies to determine what they need in order for the final product to benefit their facility and their guests
2. Travel around the island of Hawai‘i and take pictures of coral reef ecosystems
3. Assess pictures and select the most appealing ones that will get the message across
4. Edit pictures using Picasa, Adobe Photoshop, and Adobe Lightroom
5. Organize photos into a tri-fold, double-sided pamphlet with facts and tips
6. Print and Distribute the pamphlet

## MATERIALS AND METHODS

My time for this project was divided among the field work of underwater photography, lab work consisting of editing and the organization of a template to distribute, and the future distribution of the final product to local companies willing to be an advocate. I researched techniques in underwater photography and messaging to the general public, as well as focal points in tourism and how to be an eco-friendly visitor.

For the photography, I used a GoPro Hero 3+ camera and an underwater Canon camera from the Marine Option Program at University of Hawaii at Hilo. I traveled to several snorkel locations around the island to capture pictures of turtles, fish, and healthy reef systems. I purchased a macro lens for my GoPro Hero 3 camera so I would be able to capture clear, close-up shots. For the coral polyp pictures, I used the Canon underwater camera. I have used this camera for several labs and classes, so I knew how they worked. I spent a day at Richardson’s Ocean Park, Hilo, Hawai‘i, taking pictures solely of coral and coral polyps.

When I was done collecting sufficient photos, I downloaded my photos to my laptop and uploaded them to Adobe Lightroom. For most of the pictures, I increased the clarity and saturation to highlight the beauty of the coral and turtles that I photographed. After editing the pictures, I sorted them into four categories: 'Fish', 'Coral', 'Turtles' and 'Miscellaneous'.

To determine what facts I wanted to include, I had to specify my audience. I decided to target beach-going tourists with minimal knowledge about the ocean. I have combined several features to attract the most diverse audience. I included photographs for those who only have a brief moment to flip through the pamphlet, fun facts for readers with little knowledge of Hawai‘i’s marine life, answers to FAQs about Hawai‘i marine life, scientific information for readers with advanced knowledge and important advice for any reader to take from the pamphlet. I then looked at other pamphlets online to gain a sense of how a pamphlet layout is organized. Many pamphlets used many words and minimal pictures so I paid little attention to content of the other pamphlets. My goal was to use photography and brief facts to attract my targeted audience and to speak my intended message. After thorough research on constructing a pamphlet, I discovered which panels

are best for specific points or topics covered. I then sketched out a brief overview of the points that I want to be covered in the pamphlet. The topics covered in this pamphlet were based off of my work and personal experience with tourists. Currently, I work as a tour guide and receive many questions pertaining to the ocean and the organisms within. I wanted to create a pamphlet that will give the tourist access to the answers they are seeking. Some of the points included were answers frequently asked questions about turtles, a brief overview of coral biology, and list of important tips to give tourists.

As a tour guide in East Hawaii, I found that tourists need to be further educated on specific Hawai'i marine life topics. One of the most important topics to educate the public about is coral biology. Most visitors are unaware that coral is alive. It is important to highlight the vulnerability of coral reefs and how everyday routines are threatening coral reef ecosystems. I dedicated the two inside panels of the pamphlet to explaining the biology and ecology of coral. I used my own photographs to support the facts discussed in this panel and to build a connection between the reader and coral reefs.

Hawaiian Green Sea Turtles, honu, are a popular tourist attraction on the islands, and it is important for one to first understand the basic biology and behavior of honu in order to ensure a safe and friendly encounter. The panel about Green Sea Turtles includes facts, answers to FAQs and the Turtle Response Network number. Often times, the network receives calls from tourists regarding a "dead" or "injured" turtle, when actually, the turtle is just resting ashore. It is important to educate the public on the basic biology and behavior of these animals, so that people will understand their encounters with the Hawaiian Green Sea Turtle. Hawaiian Green Sea Turtles are also protected under the Endangered Species Act (NOAA 2015). Hawaiian Green Sea Turtles are vulnerable to human impacts, so it is crucial to their survival that we minimize our impact and contact with these creatures. I have provided some basic guidelines to follow when one encounters a sea turtle in the water or on the beach.

I have also included a panel about marine mammals in Hawaii. This panel is focused on providing the reader with some basic facts about Spinner Dolphins, Bottlenose Dolphins, Humpback Whales and Monk Seals such as size, migration and conservation status. I have also included the Hawaiian names for these mammals for the tourist to learn. The content of this panel was inspired by my personal encounters with tourists. I aim to answer frequently asked questions that I received from guests.

The back panel of this pamphlet is dedicated to providing the reader actionable recommendations while enjoying our oceans here in Hawai'i. I purposely placed this information on the back panel so that the reader will see this advice without opening the pamphlet. If a tourist was to pick up the pamphlet for a brief glance, they will see the title page and if they flipped it over, they will see the four pieces of advice that I have provided. These four pieces of advice are aimed to summarize the information provided in the pamphlet. The information provided is based off of my thorough research on the

biggest contributing factors to coral bleaching, harm to marine organisms, and habits that most can relate. The first piece of advice is “These animals are wild. Do not touch or feed them, we are in their home”. This is just a simple reminder that the marine organisms are not here for solely entertaining the tourist. Many tourists come to Hawai‘i to enjoy the marine life, but that does not necessarily mean that the marine life is here to entertain. This piece of advice is aimed to remind the tourist that they are a guest to the ocean. The second piece of advice is “Corals are made up of miniscule animals that provide food and shelter for the majority of the species you will see. Avoid stepping on or touching these fragile animals”. Coral is a living organism that provided the ocean with sufficient life and it is important to protect these organisms and this recommendation is to inform the reader that corals are living and vulnerable to human impacts. The third piece of advice is “Applying sunscreen more than 15 minutes prior to entering the water helps prevent excess chemicals from harming corals and fish”. This piece of advice is based off of my findings that coral bleaching and chemicals from sunscreens is related (Danovaro 2008). My fourth piece of advice is “Many of these animals mistake our trash for food. Help save their lives by picking up any trash that you see at the beach or in the water”. This piece of advice aims to remind the reader that a little piece of trash has the potential to harm an organism that they come to Hawai‘i to see.

I then purchased Adobe Photoshop and Adobe Illustrator to construct my pamphlet. I used the tri-fold template in Illustrator to start my pamphlet template. After thorough research on the program, pamphlets, and organizational techniques, I started to organize my pictures and messages. After many edits and tweaks, I completed my pamphlet template. I consulted with the Waterlust organization for advice and assistance. Waterlust is an organization that utilizes social media to get the public thinking about their relationship with Earth’s water resources. Waterlust aims to “spread the lust” for water by discussing their research, sharing footage of water sports, and holding weekly photography contests on their social media websites. The Waterlust team agreed to assist with the printing and distribution process since they have such a diverse audience across the globe. Their creative director also pointed out key concerns and key attributions of my pamphlet template that I created. This allowed me to see what changes needed to be made in order to construct a professional and successful final project. In order to ensure that this pamphlet’s content and design is well-rounded, I included facts, advice, and photography to give every reader something to enjoy. This project is designed to attract the public and send a message informing tourists how to practice eco-friendly habits as a guest of our oceans. To get this pamphlet in the hands of tourists, I have distributed this pamphlet to local tour companies and shops that are high in tourism traffic.

I printed several copies of this template and used it as a model when I spoke to local tour companies about distribution. I will ask them if they think the product will be useful to accomplishing their company's goals. I will also ask what additional points they would like to see be covered in the pamphlet. The final product is to be printed and distributed. My goal is to print a total of 500 pamphlets to distribute to snorkel rental stores, dive

shops and resort concierges. Assistance with the printing process including 100% recyclable materials and design resources will be needed.

## RESULTS

Before I started this project, I had no experience with Adobe design, pamphlet making, or professional photo editing. As a result I will provide a tangible product to distribute to companies or hotels that deal with tourism. I intend to educate and bring awareness of the importance and fragility of our coral reef systems here on Hawai'i before tourists are exposed to the ocean. My final product is intended to grab the tourists' attention using photography as well as briefly teach them why coral is threatened and how to prevent further harm to Hawai'i's marine life during their visit. This pamphlet will educate and make tourists conscious of their habits and the effects that they have on the marine life here, in Hawai'i.

I have printed 50 pamphlets thus far and used them to present at the Marine Option Program Symposium on O'ahu, April 18<sup>th</sup> 2015. The feedback I received was mostly positive. There were some suggestions that were very useful to the final stages of distributing my pamphlet. I have edited the pamphlet accordingly and am waiting to hear the feedback from Waterlust before the mass production takes place. As soon as I get my final feedback from their educational coordinator and graphic design team, I am able to move forward in the process.

## CONCLUSION

After thorough research, making connections and seeking guidance, I have acquired many skills that I did not initially have. I feel confident in my pamphlet constructing skills, as well as my ability to seek out guidance and network with organizations. For future jobs in the education and outreach in the tourism industry, I feel that I have the confidence to offer my leadership to create a pamphlet for the facility I will be working with. After the distribution process of my pamphlet, I will also gain confidence in building relationships with businesses involved in the tour industry. So far, the process of creating the pamphlet has integrated and developed many of my skills and interests. I have gained many skills such as pamphlet design and construction, experience with Adobe photo editing software, speaking to audiences with minimal ocean knowledge, and confidence in my ability to educate a diverse audience in a friendly and successful way. At times this project was discouraging and difficult, but I enjoyed the entire process. Overall, I feel that this project will lead me in the right direction of education, outreach, and tourism involvement. I hope to continue the development of my newly acquired skills and apply them in my future career.

## LITERARY SOURCES

- Alva-Basurto JC, Arias-Gonzalez JE (2014) Modelling the effects of climate change on a Caribbean coral reef food web. *Ecol Mod* 289:1-14
- Briggs JR (2002). Coral Reef Biodiversity and Conservation. *Science*, 296: 5570, 1026
- Côté, Isabelle M, Reynolds JD. Coral Reef Conservation. Cambridge: Cambridge UP, 2006. Print.
- Danovaro R, Bongiorno L, Corinaldesi C, Giovannelli D, Damiani E, Astolfi P, et al. (2008) Sunscreens Cause Coral Bleaching by Promoting Viral Infections. *Environ Health Perspect* 116:441-447
- Doiron S, Weissenberger S (2014) Sustainable dive tourism: Social and environmental impacts – The case of Roatan, Honduras. *Tourism Management perspectives* 10:19-26
- Fabinyi M (2008) Dive tourism, fishing and marine protected areas in the Calamianes Islands, Philippines. *Marine Policy* 32:898-904
- Farr M, Stoeckl N, Beg RA (2014) The non-consumptive (tourism) 'value' of marine species in the Northern section of the Great Barrier Reef. *Marine Policy* 43:89-103
- Ghaderi Z, Henderson JC (2013) Japanese tsunami debris and the threat to sustainable tourism in the Hawaiian Islands. *Tourism Management Perspectives* 8:98-105

- Giokas DL, Salvador A, Chisvert A (2007) UV filters: from sun-screens to human body and the environment. *Trends Anal Chem* 26(5): 360-374
- Guillemot N, Chabanet P, Kulbicki M, Vigliola L, Leopold M, Jollit I, Le Pape O (2014) Effects of fishing on fish assemblages in a coral reef ecosystem: From functional response to potential indicators. *Ecological Indicators* 43:227-235
- Kocasoy G, Mutlu HI, Alagoz AZ (2014) Prevention of marine environment pollution at the tourism regions by the application of a simple method for the domestic wastewater. *Desalinations* 226:21-37
- Lamb JB, True JD, Piromvaragorn S, Willis BL (2014) Scuba diving damage and intensity of tourist activities increases coral disease prevalence. *Biol Cons* 178:88-96
- Lirman D, Formel N, Schopmeyer S, Ault JS, Smith SG, Gilliam D, Riegl B (2014) Percent recent mortality of stony corals as an ecological indicator of coral reef condition. *Ecological Indicators* 44:120-127
- McIntyre AD "Human Impact on the Oceans: The 1990s and beyond." *Marine Pollution Bulletin* 31.4-12 (1995): 147-51. Print.
- Micheli F, Mumby PJ, Brumbaugh DR, Broad K, Dahlgren CP, Harborne AR, Holmes KE, Kappel CV, Litvin SY, Sanchirico JN (2014) High vulnerability of ecosystem function and services to diversity loss in Caribbean coral reefs. *Biol Cons* 171:186-194
- Rodgers KS, Jokiel PL, Bird CE, and Brown EK (2010) Quantifying the condition of Hawaiian coral reefs. *Aquatic Conservation: Mar. Freshw. Ecosyst* 20:93–105
- Rodgers K "The Effects of Trampling on Hawaiian Corals along a Gradient of Human Use." *Biol Cons* 112.3 (2003): 383-89. Print
- Sun Y (2014) A framework to account for the tourism carbon footprint at island destinations. *Tourism Management* 45:16-27