

Developing a Framework for Safe Hiking Culture along the Sendero Pacífico

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WPI



HUB FOR THE AMERICAS
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Developing a Framework for Safe Hiking Culture along the Sendero Pacífico

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Abstract

The Sendero Pacífico is a 60 kilometer long hiking trail extending from Monteverde to the Gulf of Nicoya in Costa Rica. The developing trail has potential to offer hikers unique cultural experiences and economically benefit smaller communities but lacks a culture of safety and preparedness. We worked with the World Trails Network Americas to develop a framework for safer hiking culture. Through observing the trail and interviewing outdoor leadership experts and local trail ambassadors, we identified gaps in emergency planning and communication systems. We improved hiker preparation resources, developed a handbook for guides, and created an infographic to display at hostels along the trail for the purpose of improving emergency prevention and planning by hikers, guides, and hostels.

Executive Summary

Introduction

The Sendero Pacífico is a 60 kilometer long trail that extends from Monteverde, Costa Rica, to the Gulf of Nicoya. The developing trail has potential to offer hikers unique cultural experiences and benefit smaller communities unfamiliar with the financial gains of ecotourism, but lacks a culture of safety and preparedness. Currently, the Sendero Pacífico is not accessible without a guide as a map is not publicly available and signage on the trail is limited. Because of this and the overall lack of public information about the trail, there have not been many hikers on the trail. In the future, our sponsor, the World Trails Network Americas, and the Sendero Pacífico Alliance hope the trail will attract more experienced hikers looking for a new cultural experience.

The Sendero Pacífico starts in the mountainous region and ecotourism hub of Monteverde and passes through many different small communities before ending at the Gulf. The entire trail can be completed in four to five days. Hikers spend the nights and eat meals in hostels, known locally as *albergues*, which allows plenty of opportunity for hikers and local community members to interact and exchange cultural experiences. These *albergues* generally cost 40 USD per person per night and accept both US dollars and the equivalent in the local currency of colones. With increased usage, this trail will benefit both travelers who are interested in an authentic cultural experience and small, rural communities, who will generate income from the visitors (Smith, Patricia S. et al., 2020).

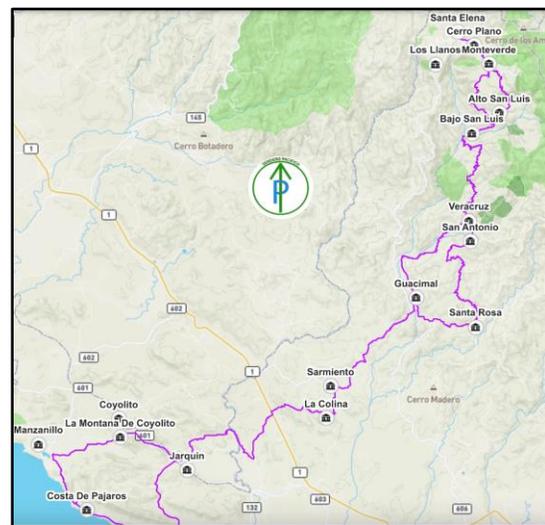
While the Sendero Pacífico has potential to offer a unique opportunity, it currently lacks the necessary trail infrastructure and emergency preparedness to safely support a higher volume of hikers. Safety concerns on the trail must be considered and hikers, guides, and hostel hosts must prepare for a possible trail-related emergency. The trail passes over various terrains, including mountainous regions, farmlands, and dirt roads. There are also different seasonal concerns, depending on whether it is the rainy season (May to November) or the dry season (November to April). In general, the common safety concerns on the trail include venomous snakes, river crossings, weather exposure, language barriers between locals and hikers, and unreliable cell service.

To prepare for these hazards, it is important that hikers and guides carry extra gear that may be useful in emergencies. In the United States, outdoor adventure communities use “the ten essentials” method to categorize gear that is helpful for survival in emergency situations. These essentials are navigation, illumination, sun protection, first aid, knife tool, fire, shelter, food, water, and insulation or clothing. By carrying gear in each of these categories, hikers would be prepared for an unexpected change of plan on the trail. Along with gear, preparation and planning prior to hiking would prevent unnecessary accidents. Since some accidents are inevitable, it is helpful for hikers and guides to have some level of wilderness first aid training.

Methodology

To promote a culture of hiker preparedness and safety, the World Trails Network Hub for the Americas aims to address the lack of infrastructure and hiker resources along the Sendero Pacífico. The goal for our project was to work alongside this organization and our point of contact Nathaniel Scrimshaw to develop a framework for a safe hiking culture. To achieve our goal, we set four objectives: understand the safety concerns and common accidents that occur along the trail, evaluate gaps in hiker preparation resources and ethical practices, identify resources along the trail that would help hikers prevent and deal with accidents, and assess the current safety protocols. To satisfy these objectives, we completed an observational study of the trail and hikers and conducted semi-structured interviews with hikers, guides, hostel hosts and community members, and outdoor leadership experts.

Our group spent four weeks in Costa Rica and hiked three sections of the trail: San Luis to Veracruz, Guacimal to La Colina, and La Colina to El Coyolito which are shown in the map to the right. As we hiked, we completed a participant observation and wrote field notes to record our observations of both the condition of the trail and the preparedness of the other hikers and the guide. We also mapped each significant safety concern we encountered on the trail using an app called WikiLoc which allowed us to log coordinates, notes, and pictures.



In addition to the observational study, we conducted interviews with four specific demographics: hikers in Costa Rica, Sendero Pacífico guides, international outdoor leadership experts, and hostel hosts and community members at each *albergue*. To better understand the safety and preparedness of hikers on the Sendero Pacífico, we interviewed hikers from another Worcester Polytechnic Institute student project that hiked the three trail sections with us and local hikers who have hiked the trail before. We also interviewed outdoor leadership experts to increase our knowledge on the common safety concerns and the gaps in preparation and expectations of hikers. We visited four *albergues*, where we interviewed community members and hostel hosts to gain insight into hosts' experience with visitors, community involvement with the trail, and their ability to assist hikers in emergency situations. Lastly, we conducted interviews with outdoor leadership experts to understand emergency protocols, resources, and preparedness for accidents along a remote trail. This methodology led us to our primary findings. We found gaps in safe hiking culture related to preparation and communication systems:

- 1. Managing expectations of the trail plays an essential role in preparation.** It is important for hikers and guides to have realistic and accurate expectations for an outdoor adventure excursion during the preparation phase of the trip. There is a limited amount of

information about the Sendero Pacífico and the condition of the trail available online, so all of the information provided to hikers before arriving at the trailhead is from a guide. Interviews with hikers revealed that they were not mentally prepared for the hike nor did they bring proper gear. Providing information about safety concerns specific to the area and resources available to hikers on the trail before the hike would have been a better way to manage hiker expectations and would have helped them prepare and pack for the hike. On the other hand, it is equally important for a guide to know what to expect out of a group of hikers. Interviews with outdoor leadership experts revealed that distributing a pre-hike questionnaire to hikers can help a guide identify strengths and weaknesses in a group and adapt to provide a more enjoyable and safer experience for the group.

- 2. Gear and experience are critical for preventing and handling accidents.** We found that proper gear and experience are essential to outdoor preparedness. Carrying appropriate gear can mitigate risk and help handle accidents when they happen. For example, on the trail, one hiker rolled her ankle multiple times and was in pain for most of the hike. Had she worn boots that supported her ankle, this could have been prevented or if the guide had taped her ankle, the situation could have been handled better. Guides and hostel hosts should also be equipped with the proper gear to handle emergency situations as they occur. Experience and knowledge of the land, group dynamics, and wilderness first aid are also essential for guides to have, so they are able to recognize and avoid potential hazards as well as know how to best handle emergency situations if they occur.
- 3. A language barrier makes the trail less safe.** A language barrier between hikers and a guide or hikers and a hostel host can be a safety hazard when giving directions about the trail or communicating other serious matters. On the trail from La Colina to El Coyolito, one of our guides only spoke Spanish as he could not communicate information about the trail and we could not communicate our concerns to him. It is concerning if communication inhibits the ability of guides and hostel hosts to be resources for hikers. Non-verbal forms of communication can be used but are less efficient in emergency situations. It is ideal if hikers can speak some Spanish or guides can speak some English, but relying solely on non-verbal communication is not advised.
- 4. Communication within groups is important to maintaining a safe hiking experience.** It is important to maintain open and honest communication within a hiking group. There are many potential hazards, so it is crucial that every member of the group feels comfortable communicating when they have an issue. The guide must encourage this environment by checking in with hikers and allowing them to express their concerns freely. For the hiker who rolled her ankle, she may not have been comfortable communicating how much pain she was in to the guide because she was already slower than the rest of the group. A guide's knowledge of group dynamics helps them facilitate open communication in a group. In addition, hiking groups need to be able to contact

help if they have an emergency. In areas with unreliable cell service, alternate communication systems would improve emergency preparedness on the trail.

Some limitations we faced in this project included language barrier between locals and tourists, transcription software difficulties, a four-week limit in Costa Rica, and the COVID pandemic. Since none of the members of our group are fluent in Spanish, it was difficult to fully understand in-person interviews, and due to difficulties with the transcription software, some sections of the interview were lost completely. Also, only being in Costa Rica for four weeks prevented us from hiking the whole trail and visiting every hostel host. We also hiked during the dry season, therefore we are not as familiar with safety concerns related to the rainy season. Lastly, the COVID pandemic prevented us from sleeping in hostels and experiencing the Sendero Pacífico in full. Also, we were unable to contact a local Red Cross, limiting our understanding of emergency response protocols in Costa Rica.

Recommendations

Our findings show that hikers, guides, and hostel hosts must all play a role in promoting safe hiking practices. The following recommendations explain how each demographic can contribute to trail safety.

We recommend that hikers are provided specific and accurate resources prior to hiking. Hikers need to be prepared before arriving at the trailhead with essential gear and realistic expectations for the difficulty of the terrain and the resources available to them on the hike. A previous student group with WPI established a comprehensive hiking guidebook for the Sendero Pacífico, and we have recommended improvements to this guidebook to include cultural considerations, specific safety concerns per section, and a more comprehensive gear list. These resources will allow hikers to prepare both mentally and physically for the hazards that they may see on the trail.

We recommend that safety infrastructure is improved as needed on the trail. Certain sections of the trail require a lot more attention than others. For example, there are steep sections and areas of harsh wind that create a lot more risk for accidents. Exploring options for safety infrastructure in dangerous areas of the trail, such as safety rails, would decrease risk of injury. Additionally, in remote sections without cell service, a radio system would allow communication in case of an emergency.

We recommend that guides are required to have Wilderness First Responder training. The Wilderness First Responder (WFR) course is recommended as it is a more comprehensive medical course than Wilderness First Aid (WFA), but any training is highly suggested. These courses prepare guides for possible emergency situations, as well as teach them leadership techniques and group dynamics strategies through simulation-based learning.

We recommend that guides develop emergency plans for each section on the trail. Planning should include *albergue* hosts and local community members. Communities along the trail should be made aware of the trail and asked about their willingness to provide resources to hikers. Guides should also prioritize having knowledge regarding how to reach the nearest road while hiking.

We recommend that hostel hosts have established protocols to handle common trail accidents. These include physical injury, snake bites, and allergic reactions, among others. These protocols should include details on what first aid measures should be applied, how to transport the injured person if they become injured on the trail, and what emergency number to call if necessary.

We recommend that hostels have emergency resources available. The World Trails Network Americas should work with *albergues* to generate lists for first-aid kits and gear to keep at the *albergues*. On top of this, hosts should have contact information available for local emergency resources, so that they can be contacted quickly.

With these safety precautions implemented, we believe the trail should be better marketed by the World Trails Network so that its benefits can be enjoyed by more visitors. The Sendero Pacífico is a unique trail because the ability to stay at hostels and interact with local community members provides a culturally immersive experience unlike the ecotourist attractions that are widely promoted in Costa Rica. Pictures and personal experiences highlighting the positive interactions between hikers and community members should be displayed online to promote the benefits of hiking the trail. Our deliverables, which are improvements to a hiker guidebook, a hostel infographic, and a manual for guides, as well as our recommendations, will help to create a safer hiking experience on the trail. After proper implementation, we believe the trail will be ready to receive more visitors.

References

Smith, Patricia S., Garcia-Duarte, Marco M., Driscoll, Kyleigh Alannah, & Medina Martinez, Maria D. (2020, March 20). *Empowering community trail development along the Sendero Pacífico* [Interactive Qualifying Project]. <https://digital.wpi.edu/pdfviewer/2v23vw908>

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1.0 Introduction

Although Costa Rica makes up only 0.1% of the world's land area, it contains 5% of the world's biodiversity (Amici et al., 2021). Because of the wide variety of flora and fauna, Costa Rica, and Monteverde in particular, is a popular destination for tourists seeking to immerse themselves in the natural environment. For the majority of these tourists, ecotourism was listed as a primary reason for travel especially in recent years (Reyes, 2020). Popular ecotourist attractions in Monteverde include national parks, hiking trails, and nature reserves. In 2001, 58.4% of tourists who came from the United States to Costa Rica visited one of these attractions (Davis, 2009). Ecotourism makes up a large portion of Costa Rica's self-image and economy. The Sendero Pacífico starts in Monteverde, Costa Rica, which receives 180,000 tourists each year (Davis, 2009). Unlike the typical ecotourist attractions mentioned above, the Sendero Pacífico provides a different type of attraction to those interested in backpacking and a more authentic cultural experience.

1.1 Sendero Pacífico and the Problem

The Sendero Pacífico is a 60 kilometer long trail that extends from Monteverde in the upper corridor to the Gulf of Nicoya in the lower corridor. Starting in the biodiverse, ecotourism capital of Costa Rica, trekkers visit unique communities and pass through various terrains, including heavily forested areas, mountainous regions, rural roads, and communities. Trail conditions, maintenance, and markings vary throughout the trail, so paid guides or volunteer *acompañantes* are recommended. Depending on whether it is the rainy season or the dry season, the trail's safety risks and recommended routes differ. Camping opportunities along the trail are available at a few locations, however they are not consistently offered or advertised. There are hostels or *albergues* located in the towns along the trail that offer lodging and meals which generally cost 40 USD per person per night. The trek offers a mutually beneficial experience for travelers who are interested in meeting local people and small, rural communities that generate income from trekkers (Smith, Patricia S. et al., 2020).

Currently, the main demographics on the trail are organized student groups and local hikers. However, our sponsor representative from the World Trails Network Americas (WTN Americas), Nathaniel "Nat" Scrimshaw, and other key stakeholders of the Sendero Pacífico, would like to make the trail more approachable for independent hikers with disposable income. Nat Scrimshaw and WTN Americas work alongside ambassadors from an informal organization, the Sendero Pacífico Alliance, to support the trail. Before efforts are made to draw more independent hikers to the trail, improvements to trail infrastructure and culture are necessary.

1.2 Seasons and Climate Change

Costa Rica experiences two seasons: the dry season (December through April) and the rainy season (May through December) (*Seasons in Costa Rica*, n.d.). During the dry season, the lower regions in Costa Rica experience hot and arid weather. In the higher mountainous regions

near Monteverde, the rainforests rely on “regular cloud immersion” to maintain a humid rainforest environment year round (Foster, n.d.). Due to global warming, the cloud forest has seen fewer occurrences of low-level clouds in the rainforest, making the dry season even drier in these areas. These weather shifts result in unique seasonal challenges and risks on a backcountry trail. For example, in the dry season, the risk of dehydration is high, whereas in the rainy season, high water levels may result in dangerous river crossings on the trail.

1.3 Safety Concerns

Traveling in the outdoors and on trails in Costa Rica pose unique safety risks to visitors. Potential safety concerns to consider when traveling between the mountainous region of Monteverde and the lower regions are weather exposure, language barrier, lack of cell service, venomous snakes, and river crossings in high water. Understanding these safety concerns more broadly can help a visitor prepare for travel in Costa Rica.

Due to Costa Rica's unique geography, it experiences a variety of weather conditions (Foster, n.d.). At higher elevations, like Monteverde and San Luis, high wind speeds cause dangerous conditions for hikers especially on exposed, deforested ridges.

Costa Rica is rich in biodiversity and harbors 23 species of venomous snakes. These venomous snakes mostly come from two families, Elapidae and Viperidae. Pit Vipers have loreal pits, which are visible raised structures on each side of the snake's head. They have triangular shaped heads and rough looking scales. Coral snakes are long and thin with an alternating banding pattern. The bands are often brightly colored (*Venomous Snakes in Costa Rica*, 2021). Snakes are more prominent in the rainy season and in highly forested areas (*Snakes in Costa Rica*, 2017). Wearing protective footwear and avoiding walking through thick brush can help prevent snake bites.

During the rainy season, the mountainous regions near Monteverde receive a high volume of water. Extremely rainy weather in higher elevations may cause rivers to flood downstream at lower elevations. River crossing may be dangerous as water levels in lower regions may rise quickly. In some cases, it may not be possible to cross rivers.

International travelers with limited Spanish speaking abilities may be safer in the region near Monteverde as the economy is driven by ecotourism and many locals speak English. In lower regions, where there is less tourism, language barrier may become a safety concern. In the event of an emergency, inability to communicate with local Costa Ricans may be dangerous. In addition, when traveling in rural and remote areas, cell service and communication with others may be limited.

1.4 Trail Safety

There are inherent risks associated with traveling in the backcountry especially in an area with minimal trail infrastructure and emergency resources. Trail safety covers accident prevention and emergency response resources.

1.4.1 Prevention

Many accidents can occur in the backcountry, and to reduce dependency on search and rescue teams and medical professionals, education about prevention methods is key. Four main aspects of accident prevention are preparation, gear, wilderness first aid training, and trail ethics. Preparation refers to the research done in the planning process of a hike while essential gear lists ensure general preparedness on the trail. Additionally, wilderness training provides the knowledge to address trail accidents. Ethical codes on the trail provide guidelines about how to conduct oneself on a trail in a manner that preserves and protects the safety of the wildlife and the hiker. Heggie and Heggie (2004), Mason et al. (2013), and Zürcher et al. (2020) found in their studies about hiker safety and behavior that the most vulnerable people to hiking accidents are young, foreign, and inexperienced hikers. This is because they are the least likely demographic to perceive risks, prepare for a trek, and have knowledge of trail ethics.

Preparation

Preparation and planning for any amount of time spent in the backcountry requires attention to the mitigation of many kinds of risk. Risk perception is an important factor in preparedness as, if the perceived risk is less than the actual risk, a hiker is more likely to under prepare and is more vulnerable to an accident. Mason et al, (2013) found that a common misconception in the White Mountains of New Hampshire was that day hikes are lower risk and require less preparation and gear. In actuality, there is an inherent risk associated with traveling in the backcountry, no matter how long the trip is.

Heggie and Heggie (2004) examined hikers' demographics, experience and preparedness for hikes in Hawaii Volcanoes National Park and found that because the hikes were tourist attractions, many people perceived less risk. While there may be more people hiking the trail, environmental hazards are still present. Each trail has its own set of risks to consider before hiking. Proper preparation requires an understanding of the risk and a hiker's own fitness and condition as well as planning of transportation, itinerary, what to bring, and what to do in case of an emergency.

Essential Gear

Preparation informs a hiker's gear list and having proper gear on the trail will help prevent accidents. Most importantly, "the ten essentials" are categories of gear that outdoors organizations have determined should be carried on every hike (*The Ten Essentials*, n.d.). These are navigation, light, sun protection, first aid, knife, fire, shelter, food, water, and clothing. Each hiking environment might require a different variation of "the ten essentials" or additional items to prepare for specific hazards in the area. *HikeSafe*, for example, is a trail safety initiative and

educational organization designed specifically for hiking in the White Mountains in New Hampshire. The *HikeSafe* gear list emphasizes rain gear and warm clothing, specific gear for the weather of the Northeast.

Wilderness First Aid

First aid knowledge is an aspect of trail safety. There are three courses geared towards wilderness-specific medical training including the Wilderness First Aid (WFA), Wilderness Advanced First Aid (WAFA), and Wilderness First Responder (WFR) training programs. These courses cover information including how to treat and prevent injuries and illness in remote regions. In addition to formal instruction, the courses allow for hands-on practice and simulation. Although all three courses cover similar material, they vary in length. Wilderness First Aid, Wilderness Advanced First Aid, and Wilderness First Responder are 16 hours, 40 hours, and 80 hours, respectively. The longer courses provide more hands-on practice (*Wilderness First Aid Colorado - Colorado Mountain Club*, n.d.). One limitation of the WFA training is that without practicing and regularly using the skills taught in the course, skill retention is likely to decrease over time and course refreshers can be helpful (Schumann et al., 2012).

Ethical Codes

Trail ethics are concerned with low-impact behavioral practices that preserve and protect the environment (Matthews, 1990). Practicing proper trail etiquette also plays a critical role in preventing accidents on the trail. *HikeSafe* and *Leave No Trace* are two successful education programs that have developed ethical codes and principles. *HikeSafe*'s code states "you are responsible for yourself, so be prepared: with knowledge and gear, to leave your plan, to stay together, to turn back, for emergencies" (*HikeSafe*, n.d.). The *HikeSafe* code emphasizes hiker safety and the responsibility of each hiker to prevent unnecessary accidents. *Leave No Trace* outlines seven principles (See Table 1) which focus on hikers' interactions with the trail related to hiker safety and trail preservation. Principle two, travel and camp on durable surfaces, suggests the importance of remaining on the trail. An analysis of trail reports and fatalities on trails in Switzerland found that many accidents occurred off the established trail (Zürcher et al., 2020). Staying on the trail prevents accidents and environmental degradation that would occur off trail.

Table 1. Leave No Trace Principles (Chen et al., 2013)

Principle	Explanation
Plan Ahead and Prepare	Plan and prepare for the trip before arriving to the outdoors by mapping out the route and potential shelter, packing all necessary equipment, and understanding how to react to the possible emergencies that could arise

Travel and Camp on Durable Surfaces	Stay on the trails and the pathways that were constructed for the purpose of travel and camp
Dispose of Waste Properly	Dispose of all wastes in the properly labeled bins and bury human feces or remove it completely from the location
Leave What You Find	Leave everything that is discovered while traveling outdoors and recover all surfaces that may have been cleared for any reason
Minimize Campfire Impacts	Bring stoves to cook or if building a fire is necessary, use an existing fire ring in campsites
Respect Wildlife	Respect the animals and plants that are discovered and leave all the wildlife alone by observing without causing disruption
Be Considerate of Other Visitors	Keep disturbances at a minimum to allow other hikers to travel as they please and be aware of when to allow another hiker to pass and when to pass another hiker

In addition to awareness regarding preparation and necessary gear for trekking, these ethical codes are intended to prevent accidents that occur on hikes.

1.4.2 Emergency Response Resources

Practicing effective accident prevention methods like thorough preparation, carrying proper gear, having wilderness first aid knowledge, and following ethical codes improves with experience. However, accidents are inevitable and emergency situation protocols are necessary. If an emergency evacuation is necessary on a hike, the general recommendation is to have one person stay with the injured person and another person search for phone service to call emergency responders (Schumann et al., 2012). Response time for medical attention is greatly increased in the backcountry. Along the Sendero Pacífico, there is limited cell coverage, but an ambulance can be called from any small town along the trail as a Red Cross is located in each town (*Ambulance Services*, 2015). If necessary, a jet ambulance may be called. It is important to note that it could take many hours for medical personnel to reach a patient and performing first aid on an injured person is crucial in that time.

1.5 Education Resources for Hikers

It is important to understand the best practices to prevent accidents and trail damage, but it is equally important to effectively communicate them to hikers. The Sendero Pacífico is not currently accessible without a guide, but the key stakeholders of the trail would like to improve trail infrastructure for use by independent hikers. Information about the trail and its safety concerns are necessary resources to support hikers without a guide.

In general, most damage to trails and threats to the safety of trail visitors is incurred through unskilled or uninformed actions. Unskilled actions are actions taken by trail visitors that know how they should act, but lack the skills to accomplish this behavior (Marion & Reid, 2007). For example, a hiker may know that food attracts bears, but not know how to tie food up or use a bear canister. Uninformed actions are actions taken by trail visitors that do not possess knowledge on best trail practices (Marion & Reid, 2007). Using the same example, a hiker may not know that food attracts bears and leave food out as a result.

Hiking education should target young and inexperienced hikers, the most vulnerable groups on the trail, for more effective accident prevention (Mason et al., 2013). In an effort not to overload visitors with information, messages should be clear, concise, and engaging (Cole et al., 1997). Informative resources should be available to hikers before and while hiking. The New Hampshire *HikeSafe* initiative can be used as a model for education and trail safety awareness. The *HikeSafe* code provides a locally relevant list of essential gear and emphasizes planning ahead, staying with a group, knowing when to turn back, and knowing how to act in the event of an emergency (*HikeSafe*, n.d.). The *HikeSafe* initiative information is outlined in an engaging and clear format on the website as well as at all trailheads and visitor centers in the White Mountains in an effort to encourage safer trail practices (Mason et al., 2013). Figure 1 demonstrates *HikeSafe*'s interactive approach to gear essentials education. The visual representation of the essentials and the expanding explanation functionality of the website provides an especially engaging and informative experience for the user.



Figure 1. *HikeSafe* Website (<https://hikesafe.com/the-code>): Interactive 10 Essentials Education

1.6 Summary

The Sendero Pacífico is currently only navigable in guided groups due to a lack of trail infrastructure and established trail safety culture and protocols. There are a variety of safety concerns that are relevant to trails within Costa Rica which require safer practices while hiking. In order to implement safer trail practices, it is important to understand the physical condition of the Sendero Pacífico, including safety concerns and safety protocols, as well as preparation of hikers and emergency or helpful resources found along the trail.

2.0 Methodology

The goal of this project was to work with the World Trails Network to address the lack of safety infrastructure and hiker resources along the Sendero Pacífico. Our methodology aimed to identify prevalent safety concerns and risk management resources for hikers along the trail. The information gathered through our methodology was then used to recommend and inform safety guidelines to prevent injury and illness on the Sendero Pacífico. The following research objectives informed the procedures used:

1. Understand the safety concerns and common accidents that occur along the Sendero Pacífico.
2. Evaluate gaps in hiker preparation resources, expectations, and practices.
3. Identify resources along the trail that would help hikers prevent and handle accidents along the trail.
4. Assess the current safety protocols in place along the trail.

The following sections present the methods that were used to achieve these objectives. First, we conducted an observational study on the trail and mapped potential environmental and safety hazards. We also conducted interviews with hikers, guides, hostel hosts and community members, and outdoor leadership experts to understand local perspectives on the trail and expert opinions about trail safety. The findings from our observations and interviews informed our recommendations for trail safety and ethics education and protocols to make the Sendero Pacífico a safer trail for all trekkers.

2.1 Observational Study

In order to understand the safety concerns and environmental hazards on the Sendero Pacífico, we evaluated the condition of the physical trail and the environmental hazards we experienced during our four weeks in Monteverde. This evaluation was performed using an observational study with the primary focus of exploring, documenting, and analyzing the physical trail (Brown, n.d.).

We hiked three sections of the trail: San Luis to Veracruz, Guacimal to La Colina, and La Colina to Coyolito and visited the *albergue* at Costa de Pájaros. We were led by our guide, Adan, who lives in San Luis and has extensive knowledge of the land and ecology in the upper corridor. Porfir, a man from La Colina, joined us to hike the last section because he knows the land in the lower corridor. Each segment was completed as a day hike with all members of our group as well as the other project group working with the World Trails Network.

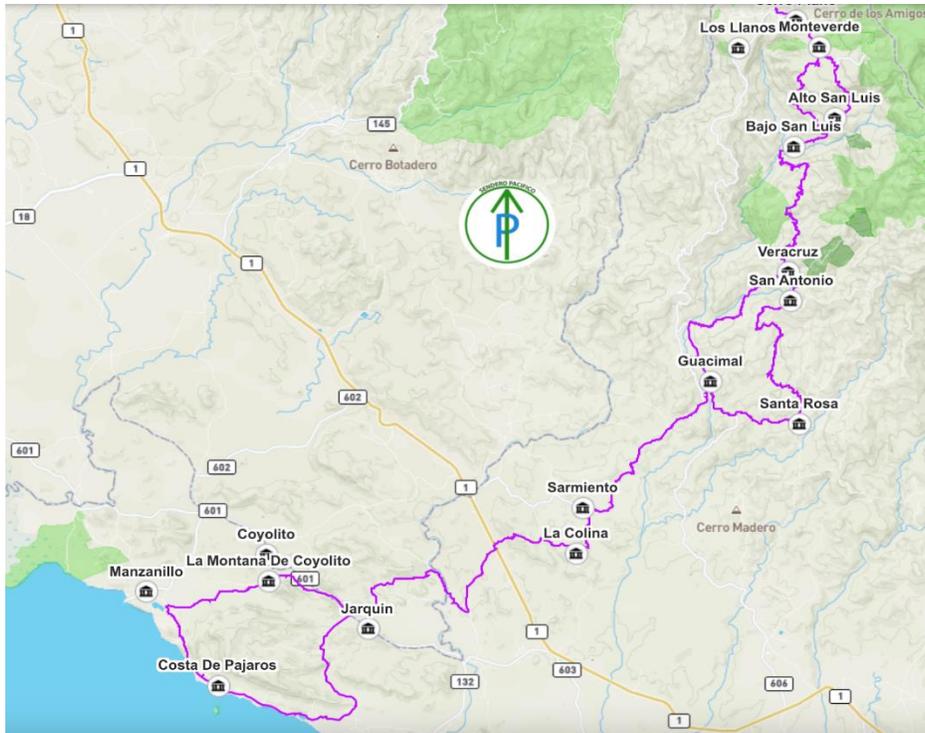


Figure 2. A map of the Sendero Pacifico: All four sections of the trail are located in the middle of the trail, and the first sections in the beginning and end were not hiked by our group (“The Trails,” 2021)

As we hiked, we recorded instances of potential safety concerns, including difficult terrain, weather exposure, strong wind, and animal sightings, and also kept field notes recounting details about the hiking experience.

2.1.1 Mapping

We mapped safety concerns through a two-step process. First, two group members were designated as observers. These two individuals mapped safety concerns as they were encountered on the trail using an app called WikiLoc, which was advised to use by our sponsor, Nat Scrimshaw (Wikiloc, n.d.). Each safety concern was mapped as a GPS point and photographed and described in the app. This method was a participatory way to record our points as well as have physical interactions with the landscape (Álvarez Larrain & McCall, 2019). The cell service was roughly tracked using the app Phone Signal. The Phone Signal app graphs cell signal over time. We used WikiLoc to record locations at different times in order to connect cell service to location.

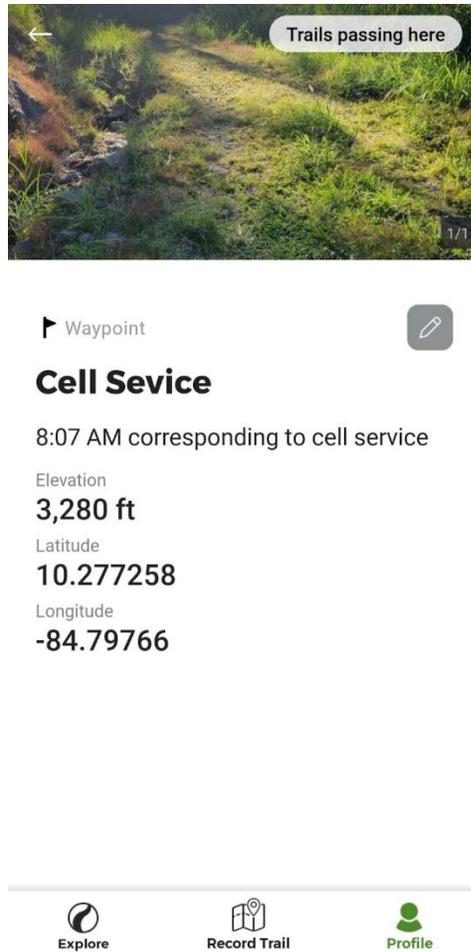


Figure 3. A WikiLoc waypoint marking the location where cell service was measured on January 25, 2022 while hiking the San Luis to Veracruz section of the Sendero Pacifico.

2.1.2 Participant Observation

While hiking we took field notes to document the events of the hike and the group dynamics subjectively. We noted our experiences with the weather, the physical trail, illness or injuries, group and guide preparedness, and group morale. This allowed us to organize our personal experiences during the hikes. These field notes provided us a personal narrative of our collective hiking experiences that we could not get from an interview (Jorgensen, 1989).

2.2 Institutional Review Board Approval

In order to protect the safety of each interviewee, we completed the Institutional Review Board (IRB) form through Worcester Polytechnic Institute. This process included a detailed application, where the purpose of our study, interview questions, and ethical guidelines were reviewed to ensure the safety of every human subject that we observed and interviewed. The certificate of our approved IRB approval (Appendix E) allowed us to begin our study and interact with human subjects under the Common Rule, 45 CFR 46 (Protections (OHRP), 2016).

To inform the participants of our study before interviewing them, we received their oral consent, which includes their consent to be interviewed and recorded (Appendix A), which is translated to Spanish for locals who do not speak English.

2.3 Interviews

We conducted interviews to understand local and foreign involvement in the Sendero Pacífico, safety and ethical concerns associated with the current trail infrastructure, and the ability of communities to manage potential emergency situations involving hikers.

Interviews were conducted with hikers, guides, hostel hosts and community members at the *albergues* along the Sendero Pacífico, and outdoor leadership experts. Participant consent was obtained before each interview (Appendix A). These interviews were structured in a semi-formal manner. Interview guides were prepared for each interview and served as conversation topics but were not meant to inhibit the natural conversational flow (Appendices B-D) (“Semi-Structured Interview,” 2008; Warren, 2001).

2.3.1 Hikers on the Sendero Pacífico

To better understand the safety and preparedness of hikers on the Sendero Pacífico, we conducted interviews with hikers from another Worcester Polytechnic Institute student project that hiked the four trail sections with us, as well as members of a local hiking group in Monteverde. The interviews with the other students provided us with information on their personal experiences on the Sendero Pacífico, and we visited the local hiking group in Monteverde to learn about their general hiking habits and preparation methods for trails in Costa Rica. For both groups, we asked questions regarding the individual's personal and hiking background to understand their perspective, pre-trip preparedness, knowledge about trail ethics, and if they had experienced any safety hazards on the trail.

This information allowed us to understand the safety and ethics knowledge and needs of locals and foreigners who have and will hike the Sendero Pacífico. Our educational efforts and recommendations for the World Trails Network were informed by the concerns and gaps in knowledge of the hikers that we interviewed.

2.3.2 Guides on the Sendero Pacífico

Sendero Pacífico guides were interviewed to better understand common safety concerns as well as gaps in preparedness and resources for both guides and their hikers on the trail. We asked questions about the guides' personal and guiding backgrounds to understand their perspectives on preparedness for both themselves and hikers before hiking, if they experienced any specific safety hazards on the trail, and how they handle accidents and emergencies in the backcountry. We followed a similar interview guide to the one for hikers.



Figure 4. Our guide, Adan, leading our hike to Veracruz

2.3.3 Hostel Hosts and Community Members

Along the Sendero Pacífico, there are small hostels, called *albergues*, run by local community members. While we were unable to stay overnight in these hostels due to COVID precautions, we used contacts provided by our sponsor to set up interviews with the hosts of the hostels in Veracruz, La Colina, Costa de Pájaros, and El Coyolito. These interviews were conducted with community members who have worked in hostels hosting hikers from the Sendero Pacífico. The interviews were conducted in conjunction with the observational study. All our hikes where we conducted observational studies ended at these *albergues* where we were able to first-hand experience their culture and conduct interviews with the hosts (Appendix C).

Interviews were recorded with audio and supplemented with written notes. Through these interviews, we gained knowledge about community involvement with the trail, the capacity of hostels and community members to assist hikers in circumstances that require medical attention, and hosts' experience with visitors.

2.3.4 Outdoor Leadership Experts

Interviews were conducted with experienced outdoor leadership personnel, both in Costa Rica and abroad, to understand common safety concerns associated with hiking along the Sendero Pacífico and hiking in general as well as leadership qualities in hiking guides. These interviews were designed to help us to understand trail-related emergency protocols, resources, and preparedness. We used an interview guide to structure these interviews (Appendix D). Interviews were also conducted with experts in Wilderness First Aid training.

2.4 Limitations

While our methodology was conducted successfully, there were some limitations. First, the language barrier was a limitation. Most interview subjects, particularly at the *albergues*, only

spoke Spanish, making conversations difficult to follow and ask follow up questions. We were aware of the varying levels of Spanish-speaking capabilities within the group; some members felt more comfortable handling conversations in Spanish, while others felt less comfortable. For this reason, this limitation was made less severe due to the more comfortable speakers carrying the conversations with the native speakers.

Some of the recordings were also difficult to transcribe due to this limitation. The transcription software had difficulty with some of the *albergue* interviews due to the number of participants and background noise. Due to the varying levels of comfortability with the Spanish language, this made it difficult to understand language where the transcription software was not completely accurate.

Another limitation of the study was timing. Only being able to spend four weeks in Monteverde meant that we were not able to interview as many people on site as we would if we were able to stay for seven weeks. On top of this, we were unable to hike all portions of the trail due to timing.

Because we were visiting Costa Rica during the dry season, we were limited in our understanding of the conditions during the rainy season. Ideally, we would have preferred to observe the trail during both the dry and rainy seasons. However, this was impossible as we were only in Costa Rica during January and February. As a result, we were never able to personally view the trail during the rainy season to better understand the safety concerns due to seasonality.

The ongoing COVID pandemic provided other limitations. Normally, the trail can be hiked in its completion with nights spent in hostels off the trail. These hostels are tightly packed, and due to the pandemic, it was not recommended that we spend nights in these hostels. For that reason, we were only able to perform day hikes on the trail, limiting our accessibility of certain sections of the trail. As a result, we did not hike the whole trail. This was a limitation because it skewed our information, specifically from our observational study, towards the sections we were able to hike.

COVID also created limitations during our interviews. Some community members at the *albergues* stayed masked and distanced. This made it difficult to hear and understand some interviewees. More specifically, this affected the audio recordings. In addition, because of COVID, there were very few hikers on and around the trail. In particular, we were the first visitors to the *albergue* in La Colina since the start of the pandemic.

It was important to keep these limitations and potential biases in mind when analyzing our data. Limitations regarding timing and seasonal limitations were mitigated through extensive research about the sections of the trail we were unable to hike as well as differences in climate and terrain during the rainy season. Overall, the limitations did not have a significant negative impact on our project.

2.5 Summary

The goal of this project was to recommend safer and more ethical trail practices to prevent injury and illness on the Sendero Pacífico and suggest stronger search and rescue

protocols to the Sendero Pacífico communities and the World Trails Network. An observational study and a series of interviews with hikers, guides, hostel hosts, and outdoor leadership experts were used to evaluate the current safety and ethical issues on the trail as well as models for preventing and managing emergency situations. The data gathered through these studies and interviews was valuable in understanding community and expert opinions. For our observational study, safety concerns on the trail were organized by mapping their locations and taking a picture of the observed concern. On top of this, our general observations were organized into field notes, separated by sections of trail. To organize our interviews into findings, we categorized each interview based on our established demographics, and then transcribed them using built in transcription software on Microsoft Word, and using built in translation software as needed. Once we had all of our transcriptions, we selectively coded each of the transcriptions until themes and key categories emerged (L. Given, 2008). Our findings are presented in the next section.

3.0 Findings and Discussion

After conducting our research, we organized our findings through common themes. We found that our common themes fell into the categories of preparation and communication.

3.1 Preparation

Through our interviews, as well as our observational study, we found that one of the biggest aspects of hiking safety is preparation. We found that there are several factors of preparation: managing expectations, as well as having the appropriate gear and experience in emergency situations.

3.1.1 Finding 1: Managing expectations of the trail plays an essential role in preparation

Throughout our interviews and personal observations, it was found that managing the expectations of trail visitors helps prepare them to prevent and handle emergencies. Adequate preparation for the trail was considered a useful way to empower hikers and guides to use common sense while hiking. According to Frank Joyce, a biologist and experienced outdoor leader in tropical habitats, having staff trained in first aid helps anticipate and prevent many accidents. For example, knowing why head injuries may be life-threatening will cause group leaders to take extra precautions in remote areas. He stated that “no knowledgeable leader would allow participants to dive into a river or lake without first assessing the presence of underwater hazards,” but a local guide that has been in the river many times before without experiencing any accidents may not think about the potential hazards. Managing expectations of the trail through preparation exists in two main steps: understanding the safety concerns of the hiking environment and identifying safety resources in that environment.

By mapping the safety concerns we encountered while hiking the trail, we were able to identify what safety concerns trail visitors should expect before hiking. All trail sections were found to have a few recurring safety risks including excessive heat and sun exposure, insect bites, and snake bites. Another consistent safety concern amongst some trail sections were river crossings that are difficult to pass in general and may be impassable during the rainy season. Due to the fact that all trail sections passed through private property or farms at various points, the chance of encountering domesticated animals, such as bulls, was high. All three trail sections that we hiked were poorly marked and difficult to navigate. Cell service was unreliable overall, but better near the roads and on the elevated sections of the San Luis to Veracruz section. Specifically in the San Luis to Veracruz section, the trail terrain was found to be steep with loose gravel on the ascending and descending portions of the trail. Towards the section of trail that was higher in elevation, there were significant amounts of mud which could be slippery and possibly impassable during the rainy season. Along the ridge of the trail, there was the possibility of extreme wind and landslides. The Guacimal to La Colina trail section passed through different communities and was hiked along roads making passing cars and vehicles a safety hazard. The trail section from La Colina to El Coyolito went along roads or traveled through private property as well. In the private property sections, long grass and loose gravel made walking difficult.

There were multiple barbed wire gates that needed to be opened or crawled through, which could result in injury. There was also a point where we needed to walk along the intercontinental highway which was a bit treacherous.

Safety concerns specific to the Sendero Pacífico were also mentioned in interviews. Some outdoor leadership experts who have hiked the trail, such as András Molnár, a co chair of Trails and Sustainability for the World Trails Network, and Fabricio Camacho, a founding member of the Bellbird Biological Corridor, noted extreme wind as a threat in the highland portions of the trail. This could potentially blow people off the trail in exposed areas between San Luis and Veracruz as well as cause a risk for falling branches. Fabricio Camacho and others noted sun and heat exposure as a risk in the lower regions of the trail. Additionally, it was recommended that hikers understand the trail terrain and difficulty level before beginning their hike.

The Sendero Pacífico is an underdeveloped trail with sections consisting of challenging terrain. Therefore, hikers may have misaligned expectations when they are preparing to walk the Sendero Pacífico. Julian Gray, the Vice-Chair of the World Trails Network, spoke on managing these expectations and understanding the environment before hiking. Within our hiking group, many of the hikers were unaware of the difficulty of the trail and were unprepared. According to the hikers we interviewed, Mike Sposato, Abby Maynard, and Malyssa Deranian, the terrain consisted of a variety of safety concerns that made it hard to navigate during their hike. The trail consisted of steep declines and inclines which were physically strenuous for more inexperienced hikers. Most of the trail also contained a lot of loose stones or gravel, which the hikers' thought were safety hazards, since it was easy to slip and fall. Malyssa believed that having a physical map, with elevation included, would have made her feel more prepared and less stressed during the hike. Preparing for the expected hike can help everyone individually make their experience not only safer but more enjoyable. Even though they carried all the gear recommended by Nat Scrimshaw, they felt as though they were not mentally prepared for the strenuous terrain, especially for the first hike from San Luis to Veracruz. Mike mentioned that after the first hike, he began to do a little more research on the trail beforehand which made him more prepared for the following sections, both physically and mentally.

It is also important that guides have accurate expectations for their hikers before arriving at the trailhead. Jed Williamson and Frank Joyce, two outdoor leadership experts, mentioned the importance of evaluating the group before going on a trip. Frank uses a "questionnaire to get to know people beforehand" which includes questions about physical fitness, medical background, and willingness to go beyond their comfort zone. Frank was adamant about letting hikers do what they want to do but having prior knowledge about their comfort level is important to help them accomplish their goals safely.

Visitors to the Sendero Pacífico should also be aware of safety resources along the trail. Outdoor leadership experts noted the importance of knowing where there is cell service along the trail in case emergency response personnel are needed. However, they recommended not having a reliance on cell service as it can be unpredictable in rural areas. The expectation to have cell service during an emergency is unreliable, so if the hikers and guide prepare to handle situations the best they can, it could save someone's life. It was also recommended to know where the nearest hospital or clinic is so that in the case of an emergency, the correct facility is contacted.

Finally, it was recommended to have information regarding alternative routes for difficult trail sections or alternative routes to the nearest community in case of emergency.

3.1.2 Finding 2: Gear and experience are critical for preventing and handling accidents

We found that gear and experience were essential to outdoor preparedness in case of an emergency. Everyone involved with the trail is responsible for being prepared to handle an injury or illness on the trail. Hikers, guides, and *albergue* hosts should have gear and knowledge on how to handle an emergency situation in order to make the trail as safe as possible.

It was found that hikers of different cultures have different preparation habits and priorities. The foreign hikers from the United States in our group, Malysa, Mike, and Abby, were fairly prepared as they brought the recommended gear listed by our sponsor contact prior to the hike and were aware of “the ten essentials”. However, on the hike from San Luis to Veracruz, one hiker rolled her ankle in the first half hour and was in pain for the rest of the hike. She was wearing hiking shoes, but they did not protect her ankle. Taller boots would have offered more ankle support. While carrying appropriate gear can help mitigate risk, anyone can roll their ankle no matter the situation. Good quality hiking gear can prevent injuries and be crucial in handling emergencies. For example, extra water is one of “the ten essentials”. During one of the hikes, one hiker did not pack enough water and ran out halfway through the hike. Luckily, he was able to drink another hiker’s water, but he could have risked dehydration which can become very serious. Carrying a water pump or small stove to purify water is an extra precautionary step to make sure that if someone was dehydrated or the group was forced to spend the night due to weather complications, obtaining more clean water would not be an issue. The idea behind carrying “the ten essentials” is that in a range of emergencies, a group has enough gear to be able to survive.

Local hikers, on the other hand, typically carry very little gear but are experienced and knowledgeable about the land. According to local hiker, Patrick Moore, hiking is a mode of transportation for people who do not own a vehicle. When members of a local hiking group in Monteverde were asked about “the ten essentials”, they were surprised and confused. They generally carry food and water but do not consider any extra safety gear. There is cell service in most of the areas they hike, so they are not worried about calling for help if necessary. They also feel comfortable asking for water at houses along a trail. While the local hikers we interviewed said that they have never been in an emergency situation on a trail, anyone can get hurt and having the proper gear to treat an injury before medical professionals arrive is key to survival.

Neither the foreign or local hikers carried all “the ten essentials” or had enough medical training to be confident in an emergency situation. According to outdoor leadership expert Frank Joyce, some safety gear is essential and should be considered no matter what the cultural context is. While some individuals may feel comfortable carrying less gear, it is especially important for guides to be prepared for emergencies when they are responsible for a group of people. Frank Joyce talked about the responsibility he feels when he guides a group of hikers and that he is usually over prepared because he does not want to be in a situation where someone dies because they did not have the proper gear. While every hiker should carry their own essentials, a guide is

responsible for thinking about the group and making sure each hiker has adequate gear. A guide may consider bringing extra emergency items for the group, including essential drugs, like epinephrine, in case of life-threatening emergencies.

Experience in emergency situations also informs a guide's risk perception and gear priorities because they know which items are necessary in certain situations. Preparation also includes having the necessary knowledge to perform first aid in case of an emergency. The more experience a person has in emergencies, the more prepared they are. That is why all of the outdoor leadership experts that we interviewed emphasized the importance of having a Wilderness First Aid (WFA) certification at least and a Wilderness First Responder (WFR) certification preferably. These two courses teach the same information but the longer WFR course requires students to practice their skills in mock emergency settings.

Wilderness first aid knowledge is crucial for a guide and hiking group in the outdoors. In the United States, it is a requirement for guides to take the Wilderness First Responder course according to Jed Williamson who co-wrote the "Manual of Accreditation Standards for Adventure Programs". In Costa Rica and other Latin American countries, these training courses are new and not widely available in Spanish. Our guide on the Sendero Pacífico expressed hesitation about taking the WFR course because it is a lot of responsibility. However, Frank Joyce said that the WFR course is "empowering" for people who are certified as they feel more confident in their ability to help someone in an emergency.

Gear preparedness is not limited to hikers and guides but also includes *albergue* hosts and community members on the trail. Currently, there is interest at the Veracruz location to get a first aid kit, medicine cabinet, and a rescue board, and a few of the hosts, specifically Dionicio, have taken the Wilderness First Aid course and are interested in renewing their certification. These emergency resources and medical experience would increase trail safety from San Luis to Veracruz since it is the only section that is far removed from people and cell reception is not reliable. In other sections of the trail where the trail is a rural road, Georgia Villaflor, a Wilderness First Response course instructor, recommended stashing extra medical resources and a backboard with a local who lives on the trail. She also emphasized the importance of a reliable communication system and its positive impact on rescue capacity.

Apart from hiking and first aid experience, every outdoor leadership expert that we interviewed emphasized the importance of guides using their evaluation of group dynamics to adapt their leadership strategies. The current state of guiding on the Sendero Pacífico is limited. There is one guide who has extensive knowledge of the upper corridor and somewhat limited knowledge and experience hiking in the lower corridor. The guide has a background in ecotourism guiding and enjoys hiking. His knowledge of the local ecology and the land is strong, however his experience with wilderness first aid and guiding groups on longer day hikes and multi-day treks is limited. He has a valid Wilderness First Aid certification from three years ago but has said that he has forgotten much of the information. While he has experience guiding groups on shorter night tours near Monteverde, he has little knowledge about group dynamics and effective outdoor communication. For example, when the hiker rolled her ankle in the first hike, she was much slower than the rest of the group for the duration of the hike. Our guide then was not able to see her and understand the extent of her pain throughout the rest of the hike. The

guide did not pay attention to the group's needs until it was clear that she should not continue hiking, and he should try to get a horse to take her the rest of the way.

A successful guide is attentive to group dynamics. Outdoor leadership is a topic of interest and research in the United States, but in other countries, it may not be emphasized in guiding programs. Jed Williamson and Frank Joyce mentioned the importance of evaluating a group before a trip. As discussed above, managing expectations for the hike is important for the hikers to know what to expect on the trail and also for the guide to know what to expect of the hikers. An experienced guide will be able to evaluate a group and identify the strengths and weaknesses in a group. On the hike described above, had the guide evaluated the group and identified the hiker with a rolled ankle and difficulty walking on rocky and steep terrain as a potential safety concern, he would have been able to mitigate the risk by making sure the group stayed together or having a more experienced hiker stay with the injured hiker in the back to help her and monitor the situation. Understanding group dynamics and being able to strategically mitigate risk comes with practice and experience, but a guide should specifically be able to communicate effectively with a group, create a comfortable environment for the group to communicate with the guide, and be able to make difficult decisions for group safety when necessary.

3.2 Communication

Through participant observation and various interviews we conducted with hikers, guides, hostel hosts, and outdoor leadership experts, we found lack of communication to be an issue for all aspects of the trail. Communication was found to be important in preventing and handling emergencies.

3.2.1 Finding 3: A language barrier makes the trail less safe

When hiking a trail that is still in development, it is important to be able to communicate your concerns. As mentioned previously, there are a variety of safety concerns prevalent throughout the trail, and injuries need to be properly communicated in order to be addressed.

One issue with communication is that local community members do not speak very good English, and some visitors do not speak very good Spanish. Because of this, it is possible that hikers would not be able to effectively communicate their needs to the locals that could help them. Patrick Moore, an experienced hiker in Monteverde, mentioned that hikers along the Sendero Pacífico utilize local community members for resources while hiking, specifically water. In addition, while we were hiking from Guacimal to La Colina, our guide had to ask the community members for directions. While our guide was capable of speaking both English and Spanish, that is not always the case. Our guide on the hike from La Colina to El Coyolito did not speak any English. This made the hike more difficult since he was not able to communicate safety concerns to the group, including barbed wire fences that we had to crawl under. Local community members are great resources to hikers, but the language barriers present are obstacles that prevent visitors from utilizing these resources to the fullest extent.

In addition, this language barrier also exists at *albergues* which can be valuable resources for hikers. However, like the other community members along the trail, these *albergue* owners do not speak English. Members from Veracruz and La Colina both expressed difficulty communicating with visitors, and there were times where our guide had to assist us in communication where we were unable to express ourselves in Spanish and the hosts were unable to express themselves in English. This is a safety concern because these hostels should be able to assist hikers when they encounter injury or illness. However, the inability to express concerns prevents them from properly assisting hikers. Both the women in the La Colina community as well as members from WPI that we hiked with expressed that they were able to find non-verbal ways to communicate when they could not communicate verbally. According to Mike, another hiker that joined us, even if he were unable to express a word in Spanish, he could try to express it in another way. Similarly, community members at La Colina expressed the ability to communicate through body language and other forms of non-verbal communication. While we were generally able to hold conversations and communicate with the *albergue* hosts, members from La Colina recognized that we had much greater Spanish-speaking abilities than most visitors do. Visitors that have less experience would have a harder time communicating and could be a significant safety concern.

3.2.2 Finding 4: Communication within groups is important to maintaining a safe hiking experience

While observing our group throughout the four sections of the Sendero Pacífico, we found that a common issue during hikes was communication, both within the group as well as with the guides. We discovered that more miscommunication within the group can result in more accidents along the trail.

For example, during the trail section from San Luis to Veracruz, a member of our hiking group rolled her ankle at the beginning of the hike. She told everyone that she felt okay to continue hiking. As the hike continued, she fell behind the rest of the group to the point where we were unable to see her, as well as another member that remained with her for most of the hike. Through this observation, we found that there was an increased risk of the two getting lost or having another accident resulting in more injury. Since she did not communicate with the rest of us the extent of her injury, we continued with the hike. However, we discovered later that her injury had worsened, and she was struggling more than we knew. If she had properly communicated her situation to the guide or if the guide had made her feel more comfortable expressing the concern sooner, it may have been possible that she could have turned back instead of continuing with the hike.

Closer to the end of the hike, our guide decided to call the Veracruz *albergue* to bring a horse for the injured hiker to ride the rest of the way. However, he was unable to reach them due to no cell reception. Having no cell reception, in this case, forced the person with the injury to continue and finish the hike. This could have been extremely dangerous if she had broken her ankle and been unable to walk or receive medical attention. From this event, we found that a lack of communication between the group can result in serious accidents.

Communication is not only the responsibility of the hiker. Guides play a very important role in maintaining consistent communication throughout a hike and making sure the whole group is doing okay, both physically and mentally.

For example, our guide should have been more attentive to the safety of the entire group. As mentioned before, not being able to see the entire group is a safety concern. Guides should be able to make difficult decisions for the good of the group. If an entire group needs to turn back because one person is hurt, the guide needs to be comfortable making that call. As Frank said, “what we care about is the wellbeing of the people we are charged with.” Apart from knowledge about the land and first aid, a successful guide should be attentive to group dynamics. This aspect of outdoor leadership is a topic of interest and research in the United States, but in other countries, it may not be emphasized in guide programs. Guides are responsible for understanding the mental and physical abilities of the group, as well as communicating the risks and gear requirements in order to manage the group’s expectations for the excursion. Jed emphasized sharing the risk with the hikers by getting an “early buy-in on safety risk and management with clients” so that the hikers feel responsible for communicating openly with the guide before there is a serious concern. One example Jed used was blisters. Blisters are often mild, but if they are not dealt with properly, they can become infected and be a major health concern. Communicating the importance of maintaining healthy feet with hikers allows a guide to share the responsibility with hikers. Guides are experts, and they need to be confident in communicating concerns with their group, making decisions, and uniting their group.

3.3 Discussion

As we looked at these findings in more detail, we noted that most safety concerns along the trail can be avoided or managed simply by improving the preparation methods and communication between all three demographics of trail users: hikers, guides, and hostel hosts. Not only do these groups need to have proper emergency preparedness measures individually, but they also need to be able to interact with one another in a way that ensures the success of these response measures.

Safety concerns along the Sendero Pacífico often result from misaligned expectations of the trail. By researching the trail before hiking, hikers and guides understand risks associated with the environment. By collecting information about the hikers, guides can accurately assess their group and ask questions that can help everyone be prepared for the possible accidents that might arise. The guide can communicate their concerns for the hikers before the hike and also prepare with any extra medications they might need. By researching the trail, hikers will also have more accurate expectations of the trail that can help them make decisions both before and during the hike.

In each of the three trail sections we encountered and mapped unique safety concerns. These different safety concerns call for different degrees of preparation in hikers as they might not expect the hike to change so drastically from section to section. In terms of safety information, the Sendero Pacífico should be considered by section to help manage hikers' expectations throughout the hike. It would be helpful to map safety concerns and provide them in a guide or website so hikers have clear expectations of the trail beforehand. While some accidents can be prevented, some accidents are inevitable. By knowing where the closest clinics

or hospitals are before hiking, trail visitors can more easily decide on where to go if an emergency situation should present itself. Having clear expectations of the Sendero Pacífico will better prepare hikers and guides on the trail.

In addition to the unique weather and terrain, hikers from other countries might be surprised by the environment of the Sendero Pacífico. The hike passed through communities and roads. It is important for hikers to be aware of this difference before they get on the trail in order to prepare mentally and physically with the right gear.

The findings show that the cultural perspective on hiking and trail safety is much different than the hiking culture in the United States. In Monteverde, local people know the land well and hiking is a mode of transportation between towns and through farms. Safety and gear is not a consideration for these hikers. They also do not generally experience emergency situations and usually have cell service wherever they go. In general, it seems that the foreign hikers have less experience and carry more gear, and local hikers have more experience but carry less gear. The gear and hiking habits of locals does work for them, so it may be difficult to suggest they implement different safety practices that are unfamiliar to them. However, there are different considerations for a local individual and a guided group of hikers. A larger group of hikers of different experience levels may be more at risk for accidents, so a guide with extensive first aid and group leadership knowledge is essential.

Recommending gear lists to hikers is fairly straightforward and since they would be paying for the guide and to stay in the *albergues*, they are more likely to follow instructions. *Albergue* hosts are more likely to agree to improving safety infrastructure (medical training, rescue boards, communication systems, etc.) because they have already invested in the *albergues* and would economically benefit from increased trail usage. It is the guides who will need to take the Wilderness First Responder course, carry more safety gear, and develop more group leadership skills. This may be a limitation of recruiting ecotourism guides for guiding on the Sendero Pacífico as the guiding knowledge and skillset is very different for two hour guided tours and six day treks.

A considerable limitation of these safety resources and training is the cost. The Wilderness First Responder training costs a considerable amount and takes eight to ten days to complete. Training for guides and *albergue* hosts would require fundraising and time flexibility of the students.

When we personally prepared to hike the Sendero Pacífico, we did not initially consider the role communication would play in hiking safety. Especially when hiking on difficult and unfamiliar terrain, poor communication can exacerbate, or even cause, safety issues.

To mitigate the issues around language barrier, there are two possible solutions: improving verbal communication or utilizing more non-verbal communication. The first solution seems unlikely since, even if local community members were to improve their English, not all hikers will even speak English. It is also unreasonable to require hikers to speak Spanish to hike the trail. Instead, a non-verbal approach to communication would be a good way to lessen the language barrier. An infographic would be a useful way to accomplish that. These infographics

would utilize symbols to enable communication of essential information between hikers and community members.

Additionally, the concerns around group communication can be addressed through guide training that focuses on group dynamics. We found that the lack of emphasis on understanding group dynamics for guides in Costa Rica to be culturally different from other trails we are used to. However, this area of guiding is equally as important as understanding the trail you are hiking.

4.0 Recommendations

Through discussing our findings, we realized that safety is not a straightforward concept that can be addressed with one change – instead, improving safety is a community effort. With that in mind, we identified areas of improvement for hikers, guides, and hostel hosts. Each of these demographics play a role in maintaining safe hiking conditions on the Sendero Pacífico. Before trail ambassadors can expect more visitors, they must work to build a culture of safety and preparedness. Once our safety recommendations are considered and applied to the trail, we are recommending that the World Trails Network market the trail to attract more visitors. Then, we believe the *albergue* hosts and community members will see a return on their investment and foreign hikers and local communities alike will enjoy the benefits of a rich cultural experience.

4.1 Hiker Safety and Preparation Resources

To improve hiker safety along the trail, we recommend that the World Trails Network Americas as well as the Sendero Pacífico Alliance provide resources to properly prepare for hiking the Sendero Pacífico. In 2020, a student project group from Worcester Polytechnic Institute created a trail guide for hikers with information about planning, navigation, gear, communication, and accommodations (Smith, Patricia S. et al., 2020). This guide is an important resource for hikers, but does not focus enough on safety. Hiker preparation depends heavily on gear and realistic expectations for the trail and resources available on the trail.

One of our project deliverables is a list of recommendations and additions to the 2020 trail guide that we believe will better promote hiker safety. Our additions to the guide include a cultural considerations section which will encourage visitors to follow the lead of the guide and be respectful of the natural ecosystem, a more in depth gear list and first aid kit information based on “the ten essentials” model, and descriptions of specific safety concerns by trail section. We recommend that information and suggestions for which sections would be best as day hikes be added to the guide. We are unable to add this as we did not hike the entire trail. We also recommend this trail guide be reviewed by our sponsor and the Sendero Pacífico ambassadors and translated into Spanish so that it is more accessible.

We also recommend publishing a publicly available map of the trail including distances and elevations. We understand that WTN Americas is considering a potential partnership with a mapping company to publish a map phone app. We believe this would be very beneficial for hiker safety and the future of the trail. We would recommend including information about safety concerns and emergency contacts and protocols on this app if the project is completed.

As for the physical trail, some sections of the trail lack adequate safety infrastructure in areas where there are strong winds or dangerous river crossings. Some solutions could be to build safety rails and implement a radio communication system where terrain is rough and cell service is unreliable. This would be especially important on the San Luis to Veracruz section where high wind speeds can be dangerous on the mountain ridges and it is the most remote section. With the implementation of new infrastructure like safety rails, maintenance is necessary. Rails would need to be checked regularly by the guides or other hikers that are hiking

the trail and reported to hostel hosts or ambassadors of the Sendero Pacífico Alliance when maintenance is required. We also suggest implementing a radio communication system to allow for communication between guides and hostels in remote areas. On many sections of the trail, there are houses where hikers can request food, water, or to call for help in an emergency, however in the San Luis to Veracruz section, these resources do not exist. It is suggested that the San Luis and Veracruz albergues participate in planning for emergencies on this section of the trail, so they can be more involved and understand their responsibility for hiker safety in this section of the trail.

Lastly, we recommend that the 2020 hiking trail guide and our additions be translated into Spanish and be accessible online in both English and Spanish. This will help to better manage hiker expectations of the trail and encourage them to prepare appropriately.

4.2 Guides and Outdoor Leadership

One of our deliverables is a handbook for guides which will outline training options, logistical responsibilities, gear lists, and safety considerations by trail section. The table of contents for this handbook is listed in Appendix F. Further recommendations for how to improve outdoor leadership and our handbook are explained below.

To improve trail safety, we recommend that guides are required to take the Wilderness First Responder course as it best prepares students with the confidence to act in emergency situations. If time and money resources do not allow, the Wilderness Advanced First Aid course is recommended at least. The Wilderness First Aid course covers basic first aid information but prepares students the least for practical situations. It is recommended that guides also carry a wilderness first aid handbook, which is available in Spanish, on the trail. We also recommend WTN Americas explore fundraising opportunities or grant programs to cover the costs of these courses. WTN Americas runs an annual collaborative Costa Rica Field School in collaboration with the Sendero Pacífico Alliance. In 2019 this included a Wilderness First Aid training for locals. The Field School has been limited for the last two years because of the pandemic, WTN Americas plans to return with a full program in 2023. We recommend that the 2023 Costa Rica Field School include Wilderness medicine (both the WFR and WFA certifications) programs for locals.

It is also recommended that the WTN Americas Costa Rica Field School include an outdoor leadership training for guides. A limitation of this recommendation is that there may not be a course readily available in Spanish. Guides should be encouraged to focus on evaluating a group's strengths and weaknesses before the trek, adapting their leadership strategies for the group's needs, and facilitating open communication within the group. One tool guides can use is a pre-hike questionnaire to collect information about hikers' medical background, physical fitness, and hiking experience.

The guide should also assume responsibility for communicating expectations for the hike to the group. Before the hike, they should provide an itinerary and map, descriptions of the physical trail, an explanation of possible risks on the trail and how to prevent and handle them, and a gear list.

On the trail, a more reliable communication system should be implemented. The guide should be able to communicate with the *albergue* hosts so that they know when the group is expected to arrive. In some sections of the trail, a radio system would be useful, and in other sections where people live nearby and could be asked for help in an emergency, guides may find that the current communication system with *albergues* suffices.

Emergency plans should also be developed for each section of the hike. Planning should include *albergue* hosts and local community members. Emergency planning should focus on establishing communication with community members along the trail who are able to call for medical help and a map or knowledge about exit strategy and routes to the nearest road at every point on the trail. For trail sections on rural roads, every person who has property along the trail should be aware of the trail and should be asked if they are willing to provide water or stash extra medical materials on their property for hikers, and then a map of where extra emergency materials are stashed should be created.

4.3 Hostel Hosts and Emergency Preparedness

Based on our findings, we have multiple recommendations to improve the emergency preparedness of hostel hosts. These recommendations include taking an active role in planning emergency protocols and providing resources for hikers.

We recommend that hostel hosts take the Wilderness First Aid course at the WTN Americas Costa Rica Field School so they are able to stabilize hikers who may experience common trail accidents including head injuries, wounds, snake bites, and allergies. Hostel hosts should be prepared for hiker injuries by being able to use a first aid kit and calling an ambulance if necessary. It is recommended that hostel hosts at the San Luis and Veracruz *albergues* consider taking the Wilderness First Responder training as the connecting trail is the most difficult and risky section for hikers. These hostels may also want to have a backboard and padding in case they need to rescue a hiker on the trail.

In addition to providing emergency assistance, we recommend that hostel hosts provide extra resources such as pre-packaged food, a water source, a first aid kit, and emergency contact numbers at their *albergue*. We recommend that the first aid kits at hostels be purchased by the WTN Americas and distributed to hostels. This will ensure that the kits are complete and each hostel has the same materials. First aid kits will need to be maintained and items replaced after use. Even for hikers who are not planning to stay at an *albergue*, hostels can still be a resource to them. One of our deliverables was an infographic template, with messages in Spanish and English, that can be customized and posted at each *albergue* to communicate to hikers what resources are available to them. These recommendations will improve emergency preparedness of *albergues* and increase resources available to hikers along the trail.

4.4 Trail Marketing

Once these safety precautions are implemented, the next step for the Sendero Pacífico is attracting more visitors. Due to the lack of public information about the trail and the COVID pandemic, there are not many hikers on the trail. We believe that a marketing project would attract more attention to the trail and unique experience it offers.

The trail is unique because hikers travel through diverse Costa Rican communities and interact closely with the local community members. The *albergues* offer an authentic and culturally immersive experience for visitors which differs from the popular ecotourism experience in Monteverde. We recommend highlighting cultural aspects of the trail in the marketing project including information about Leonels beekeeping farm, David's sculpture studio, and the Costa de Pajaros responsible fishing zone and butterfly garden.

Establishing a greater social media presence and improving the webpage would help encourage more community interaction and interest in the trail. Currently, the Sendero Pacífico page on the World Trails Network website does not provide information about the hiking experience, visiting the hostels, and interacting with community members. Additionally, the Sendero Pacífico website is also underdeveloped, containing very little information regarding the trail, its conditions, and the benefits of hiking it. WTN Americas is working with FarOut Guides on developing a map and guide, which would be invaluable resources for hikers. However, we mostly recommend changes to current webpages to market the trail as an enjoyable cultural experience in order to attract more visitors. Having the ability to visit small communities, exchange cultures, and support them economically is a very rewarding experience that can be enjoyed by both tourists and native Costa Ricans. One way to express the benefits of this experience is to incorporate user experiences into the social media presence. Highlighting pictures, anecdotes, and hikers' comments regarding the trail would make it more engaging, relatable, and attractive to viewers. More surveys or research should be conducted to determine the best way to approach advertising this specific experience to the public.

4.5 Conclusion

The Sendero Pacífico passes through multiple communities and environments from Monteverde to the Gulf of Nicoya. Currently, the trail is difficult to navigate without a guide and contains many unique safety concerns. The goal of our project was to work with the World Trails Network Americas to address the lack of safety infrastructure and education resources for the hikers along the Sendero Pacífico. We conducted an observational study and a series of interviews with hikers, guides, hostel hosts, and outdoor leadership experts in order to understand the safety concerns and risks along the Sendero Pacífico, evaluate gaps in hiker preparation resources and ethical practices, identify resources along the trail to help hikers prevent and handle accidents along the trail, and assess the current safety protocols in place along the trail. The findings informed our recommendations to the World Trails Network Americas including preparation and communication resources that will improve trail safety for hikers, guides, and hostel hosts. Our recommendations to improve trail safety and infrastructure were compiled in a trail guide for hikers, a handbook for guides, and an infographic for hostels along the trail.

While our project focused on improving hiker safety, there are additional ways to continue trail development in the future. A project focusing on showcasing the culture along the trail would both attract more visitors and economically benefit local communities.

References

- Ambulance services*. (2015, July 24). <https://www.costarica.com/relocation/ambulance-services/>
- Amici, A. A., Nadkarni, N. M., Lackey, N. Q., & Bricker, K. S. (2021). Conservation, education, and adventure tourism: A case study of adventure parks as potential venues for communication in Monteverde, Costa Rica. *Journal of Ecotourism*, 0(0), 1–16. <https://doi.org/10.1080/14724049.2021.1933503>
- Brown, L. (n.d.). *Collecting data through observation*. Retrieved February 7, 2022, from <https://faculty.washington.edu/wpratt/MEBI598/Methods/Collecting%20Data%20Throug%20Observation.htm>
- Chen, S., Mason, N., Salazar, W., & Middleton, S. (2013). Outdoor ethics and Appalachian Trail hikers: An investigation of Leave No Trace practices. *KAHPERD Journal*, 51(1), 55–64.
- Cole, D. N., Hammond, T. P., & McCool, S. F. (1997). Information quantity and communication effectiveness: Low-impact messages on wilderness trailside bulletin boards. *Leisure Sciences*, 19(1), 59–72. <https://doi.org/10.1080/01490409709512239>
- Davis, J. (2009). *The creation and management of protected areas in Monteverde, Costa Rica*. Environment & Society Portal. <https://www.environmentandsociety.org/mml/creation-and-management-protected-areas-monteverde-costa-rica>
- Foster, P. (n.d.). *The potential negative impacts of global climate change on tropical montane cloud forests*. Retrieved February 9, 2022, from <https://docplayer.net/472952-The-potential-negative-impacts-of-global-climate-change-on-tropical-montane-cloud-forests.html>
- Given, L. (2008). Codes and Coding. In *The SAGE Encyclopedia of Qualitative Research Methods* (pp. 86–88). SAGE Publications, Inc. <https://doi.org/10.4135/9781412963909>
- Heggie, T. W., & Heggie, T. M. (2004). Viewing lava safely: An epidemiology of hiker injury and illness in Hawaii Volcanoes National Park. *Wilderness & Environmental Medicine*, 15(2), 77–81. [https://doi.org/10.1580/1080-6032\(2004\)015\[0077:VLSAEO\]2.0.CO;2](https://doi.org/10.1580/1080-6032(2004)015[0077:VLSAEO]2.0.CO;2)
- HikeSafe*. (n.d.). Hike Safe. Retrieved November 29, 2021, from <https://hikesafe.com/>
- Jorgensen, D. L. (1989). *Participant observation: A methodology for human studies*. SAGE Publications.
- Laat, I. A.-V. der. (2015). Ecotourism, stated preferences, a paradox between environmental awareness and environmental actions: The case of Monteverde, Costa Rica. *Low Carbon Economy*, 6(4), 96–104. <https://doi.org/10.4236/lce.2015.64011>
- Marion, J. L., & Reid, S. E. (2007). Minimising visitor impacts to protected areas: The efficacy of low impact education programmes. *Journal of Sustainable Tourism*, 15(1), 5–27. <https://doi.org/10.2167/jost593.0>

- Mason, R. C., Suner, S., & Williams, K. A. (2013). An analysis of hiker preparedness: A survey of hiker habits in New Hampshire. *Wilderness & Environmental Medicine*, 24(3), 221–227. <https://doi.org/10.1016/j.wem.2013.02.002>
- Matthews, B. E. (1990). *Incorporating outdoor and environmental ethics in your program*. <https://eric.ed.gov/?id=ED330508>
- Protections (OHRP), O. for H. R. (2016, February 16). *45 CFR 46* [Text]. HHS.Gov. <https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/index.html>
- Reyes, R. (2020, February 12). *Monteverde plans to grow with focus on sustainable tourism* : The Tico Times. <https://ticotimes.net/2020/02/12/monteverde-plans-to-grow-with-focus-on-sustainable-tourism>
- Schumann, S. A., Schimelpfenig, T., Sibthorp, J., & Collins, R. H. (2012). An examination of wilderness first aid knowledge, self-efficacy, and skill retention. *Wilderness & Environmental Medicine*, 23(3), 281–287. <https://doi.org/10.1016/j.wem.2012.04.005>
- Seasons in Costa Rica*. (n.d.). Retrieved January 24, 2022, from <https://costa-rica-guide.com/travel/weather/seasons-in-costa-rica/>
- Semi-structured interview. (2008). In L. M. Given, *The SAGE Encyclopedia of Qualitative Research Methods*. SAGE Publications, Inc. <https://doi.org/10.4135/9781412963909.n420>
- Smith, Patricia S., Garcia-Duarte, Marco M., Driscoll, Kyleigh Alannah, & Medina Martinez, Maria D. (2020, March 20). *Empowering community trail development along the Sendero Pacífico* [Interactive Qualifying Project]. <https://digital.wpi.edu/pdfviewer/2v23vw908>
- Snakes in Costa Rica*. (2017, May 8). CostaRica.Org. <https://costarica.org/animals/snakes/>
- The International Ecotourism Society. (n.d.). What Is Ecotourism—The International Ecotourism Society. *The International Ecotourism Society*. Retrieved February 9, 2022, from <https://ecotourism.org/what-is-ecotourism/>
- The Ten Essentials*. (n.d.). Retrieved December 15, 2021, from <https://www.rei.com/learn/expert-advice/ten-essentials.html>
- The trails. (2021). *Sendero Pacífico*. <http://senderopacifico.net/index.php/the-trail-2/>
- Venomous snakes in Costa Rica*. (2021). <http://www.icp.ucr.ac.cr/en/information-and-materials/venomous-snakes-costa-rica>
- Warren, C. (2001). *Handbook of interview research* (J. Holstein & J. Gubrium, Eds.). SAGE Publications, Inc. <https://doi.org/10.4135/9781412973588>
- Wikiloc. (n.d.). *Wikiloc*. Wikiloc. Retrieved February 25, 2022, from <https://www.wikiloc.com/navigation-app>
- Wilderness first aid Colorado—Colorado Mountain Club*. (n.d.). Colorado Mountain Club. Retrieved March 3, 2022, from

https://cmc.org/Classes/CMCClassesandSchools/WildernessFirstAid.aspx?utm_source=google&utm_medium=cpc&utm_campaign=Activity-USA&utm_content=WFR&gclid=Cj0KCQiA3-yQBhD3ARIsAHuHT64KckHo89RkuKBkmuKwOwxHoXH-hAXEyIUyLjfCs26wP0kpo2bx5YIaAjUJEALw_wcB

Zürcher, S., Jackowski, C., & Schön, C. A. (2020). Circumstances and causes of death of hikers at different altitudes: A retrospective analysis of hiking fatalities from 2003–2018. *Forensic Science International*, *310*, 110252.
<https://doi.org/10.1016/j.forsciint.2020.110252>

Appendix A

Oral Consent Script in English and Spanish

Hello, we are a group of students from the American University Worcester Polytechnic Institute. We are working with the World Trails Network to help address the lack of safety infrastructure and education on the Sendero Pacífico, and will be creating a report that will be published by our university as well as going to the World Trails Network. Do you consent to being interviewed regarding your experiences with the trail? Do you consent to us recording this interview? If there are any questions you do not want to answer, you can let us know, and you can also leave the interview at any time. Finally, it is possible that we may be using quotes from this interview in our report. Would you prefer to have your name kept confidential if this is the case?

Hola, somos un grupo de estudiantes de una universidad en los Estados Unidos. Trabajamos con la organización World Trails Network para mejorar la infraestructura y seguridad en el sendero pacífico. ¿Está cómodo con esta entrevista? Su participación es completamente voluntaria y puede retirarse a cualquier momento. Nos gustaría saber si nos permitiría usar su nombre o desea mantener su identidad anónima. ¿También está cómodo con que lo grabemos?

Muchas gracias por su participación.

Appendix B

Hikers/Guides Interview Criteria and Questions (English and Spanish version)

Criteria for participants: Must be over the age of 18 and have hiked the trail, either local or international

Interview Guide:

1. What is your background? Where are you from? Where do you live? What is your age?
What languages do you speak?
 - a. *¿Dónde vive? ¿Cuántos años tiene? ¿Cuales idiomas habla?*
2. What is your prior hiking experience?
 - a. *¿Cuánta experiencia tiene con hacer caminatas?*
3. What drew you to the Sendero Pacífico?
 - a. *¿Por qué escogió el Sendero Pacífico?*
4. Which sections of the Sendero Pacífico did you hike?
 - a. *¿Cuáles secciones del sendero ha caminado?*
5. Have you hiked any other trails in Costa Rica? How does the Sendero Pacífico compare to the other trails you have hiked?
 - a. *¿Ha caminado otros senderos en Costa Rica? ¿Cómo compara el Sendero Pacífico con los otros senderos?*
6. Was the trail easy to navigate?
 - a. *¿Fue fácil navegar por el sendero?*
7. While hiking, what safety concerns did you encounter or are you anticipating?
 - a. *¿Durante la caminata, cuáles problemas de seguridad encontró?*
8. What kind of animals or wildlife did you encounter on the trail?
 - a. *¿Qué tipos de animales encontró en el sendero?*
9. Are there any animals or plants that you may be worried about?
 - a. *¿Durante la caminata, está preocupado por algunos tipos de animales o plantas?*
10. What are appropriate and inappropriate ways that people use the trail?
 - a. *¿Hay prácticas inapropiadas usadas en el sendero?*
11. What do you do to stay safe on the trail?
 - a. *¿Qué hace para que esté seguro en el sendero?*
12. What do you do to protect the wildlife?
 - a. *¿Qué hace para proteger la naturaleza durante la caminata?*
13. What did you do to prepare for your hike?
 - a. *¿Cómo prepara para la caminata?*
14. Did you bring a First Aid kit? How much water? How much food? What extra clothing and equipment did you bring?

- a. *¿Trajo un botiquín de primeros auxilios? ¿Cuánto agua trajo? ¿Cuánta comida trajo? ¿Hay otras cosas importantes que trajo?*
15. Did you do any research before hiking? If so, what resources did you use and what did you find the most helpful?
- a. *¿Hizo alguna investigación antes de caminar? ¿Si lo hizo, qué recursos usó y qué aprendió?*
16. Did you feel prepared for this hike?
- a. *¿Se sintió preparado para la caminata?*
17. Was there any information you wish you knew before hiking the trail?
- a. *¿Hay más información importante que esperó que sabía antes de caminar?*
18. Did you encounter anything unexpected on the trail?
- a. *¿Encontró algo inesperado en el sendero?*
19. What changes to the trail could be made to improve your hiking experience?
- a. *¿Qué cambiaría sobre el sendero para mejorar su experiencia?*

Appendix C

Hostel Hosts Interview Criteria and Questions (English and Spanish version)

Criteria for participants: Must have worked in a hostel hosting hikers from the Sendero Pacífico before and during the pandemic.

Interview Guide:

1. What is your background? Where do you live? Age? Languages? Community? Medical training? How long have you been working with the hostel?
 - a. *¿Dónde vive? ¿Cuántos años tiene? ¿Cuáles idiomas habla? ¿Tiene algún entrenamiento médico? Por cuántos años ha trabajado/ ha tenido el albergue?*
2. How has the pandemic impacted your hostel services?
 - a. *¿Cómo ha afectado la pandemia los servicios de su albergue?*
3. What is your community's relationship with the Sendero Pacífico and its hikers?
 - a. *¿Cómo es su relación entre su comunidad y el Sendero Pacífico y los senderistas?*
4. How much interaction do you have with the hikers as a hostel host?
 - a. *¿Cuánta interacción tiene con los senderistas?*
5. What is your experience with hikers on the Sendero Pacífico?
 - a. *¿Cómo es su experiencia con los senderistas del Sendero Pacífico?*
6. Would you and your community benefit from increased trail usage?
 - a. *¿El uso aumentado del sendero beneficiaría a su comunidad?*
7. Have you ever hiked the trail? Which sections have you hiked?
 - a. *¿Ha hecho partes del Sendero Pacífico? ¿Cuáles partes?*
8. Would you feel comfortable answering questions about the Sendero Pacífico if hikers asked?
 - a. *Está cómodo contestando preguntas de los senderistas? Puede dar información o ser un recurso para ellos?*
9. What would you do if there is an emergency (someone is injured/sick, someone needs medical attention on the trail and a messenger comes to your hostel or town)? Do you feel prepared for that?
 - a. *Si hubiera una emergencia en el sendero (como alguien tiene una herida o está enfermo y alguien necesita atención médica y un mensajero viene a su albergue? ¿Piensa que está preparada para esta situación?*
10. Where would you direct someone in need of medical attention?
 - a. *¿Adonde dirigiera usted a alguien si necesita atención médica?*
11. Have you ever had to deal with a trail related emergency?
 - a. *¿Tiene experiencia ayudando a alguien en una emergencia médica en el sendero?*
12. What suggestions do you have for improving the trail and hiker safety?

- a. *¿Qué sugerencias tiene para mejorar el sendero y la seguridad de los senderistas?*
13. Are you willing to provide resources about trail safety at your *albergue*?
- a. *¿Está dispuesto a dar recursos sobre la seguridad del sendero en el albergue?*

Appendix D

Outdoor Leadership Experts Interview Criteria and Questions

Criteria for participants: Must be over the age of 18 and have experience with guiding groups.

Interview Guide:

1. What is your background: Where do you live/Which community are you a part of? What is your age? What languages do you speak?
2. Where do you work? How long have you worked there? Do you have any training or knowledge about how your organization would handle an emergency medical situation on a hiking trail?
3. Do you or your staff have any medical training? What training program did you take? Do you ever refresh your medical training?
4. What accidents are you trained for and feel comfortable handling?
5. What are the most common accidents that you see at your organization? How often are there accidents that need assistance from a trained professional?
6. If an accident occurs on a trail or remote location, how would you get the injured/sick person to medical attention?
7. Do you have any recommendations on how to improve the emergency response protocols for guides in remote locations?

Appendix E

IRB Certification Approval

WORCESTER POLYTECHNIC INSTITUTE

100 INSTITUTE ROAD, WORCESTER MA 01609 USA

Institutional Review Board

FWA #00030698 - HHS #00007374

Notification of IRB Approval

Date: 13-Jan-2022

PI: Sarah Strauss

Protocol Number: IRB-22-0288

Protocol Title: Sendero Pacífico Safety and Trail Ethics

Approved Study Personnel: MacGregor, Michael J~Cork, Maren~Hadley, Grace E~Drasser, Rachel L~Strauss, Sarah~

Effective Date: 13-Jan-2022

Exemption Category: 2

Sponsor*:

The WPI Institutional Review Board (IRB) has reviewed the materials submitted with regard to the above-mentioned protocol. We have determined that this research is exempt from further IRB review under 45 CFR § 46.104 (d). For a detailed description of the categories of exempt research, please refer to the [IRB website](#).

The study is approved indefinitely unless terminated sooner (in writing) by yourself or the WPI IRB. Amendments or changes to the research that might alter this specific approval must be submitted to the WPI IRB for review and may require a full IRB application in order for the research to continue. You are also required to report any adverse events with regard to your study subjects or their data.

Changes to the research which might affect its exempt status must be submitted to the WPI IRB for review and approval before such changes are put into practice. A full IRB application may be required in order for the research to continue.

Please contact the IRB at irb@wpi.edu if you have any questions.

Appendix F

Handbook for Guides: Table of Contents

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