

# **Designing for Bikepacking: A Holistic Approach**

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## Introduction

While playing or engaging in many sports an athlete only demands performance from their apparel and equipment for, at most, several hours and sometimes for only several seconds. Often, during these moments of engagement, the athlete is performing a repetitive set of movements, such as running, lifting, kicking, dribbling, or peddling in environments that have been curated to be as consistent as possible in order to both literally and figuratively level the field of play. This consistency allows the design of the related apparel and equipment to provide for a more shallow set of needs and jobs to be done. Other sports, by their very nature, demand a greater level of immersion, both in terms of participation and design. Some even require an entire shift in lifestyle to participate, sometimes for only a day, but often for weeks and sometimes months at a time. While engaging in such sports, an athlete's entire way of being changes. While any athlete will be experiencing the world in a different way during the brunt of their physical exertion (and possibly for a brief time before and after), these particular sports change how the athlete rests, sleeps, and shelters, how they consume and prepare nutrition, how they maintain their personal hygiene and provide for their healthcare, how they use and maintain their equipment and apparel and even how they relate and engage with their environment and other people. Because of this, these sports require equipment and apparel that is designed with a consideration of the athlete's needs during the peak of their physical exertion as well as many other user moments.



A bikepacker on the Oregon Timber Trail. Photo by Conan Thai

## What is Bikepacking?

Bikepacking is the epitome of one of these transformative sports. Designing for it well requires examination of the sport in its totality; experientially, technically, and socially. The word bikepacking, a portmanteau of the words biking and backpacking, combines elements of road cycle touring (using a bicycle as a means of recreational travel on pavement) and backpacking. As opposed to road cycle touring, bikepacking

routes are designed to maximize time spent on gravel roads, double-track and single-track mountain bike trails while carrying supplies and equipment without additional support vehicles or personnel. Bikepacking is defined most eloquently as follows:

Bikepacking is the synthesis of all-terrain cycling and self-supported backpacking. It evokes the freedom of multi-day backcountry hiking and travel off the beaten path, but with the range and thrill of riding a nimble bicycle. It's about venturing further into places less traveled, both near and far, via single track trails, gravel, and forgotten dirt roads, carrying the essential gear, and not much more. (Bikepacking.com, 2022)

### **History of Bikepacking**

The history of bikepacking is hard to nail down. It could be said to be conceived at different points throughout history and in several places in the world. As is the case with other sports, the most recognizable origins of bikepacking were developed out of military experimentation and innovation.

During the turn of the century in America, there was a booming interest in bicycles for recreation and transportation purposes. This boom also captured the attention and imagination of the U.S. military and in 1896, The 25th Infantry, a company of enlisted black men stationed at Fort Missoula in Montana, was charged with discerning the capability of the bicycle for military transportation. After a series of training missions in the nearby Mission Mountains and 800 mile trip to Yellowstone national park, the troop embarked on a 1900-mile journey from Missoula, Montana to St. Louis in 1897, which they completed that same year (Fortmissoulamuseum.org, 2022).

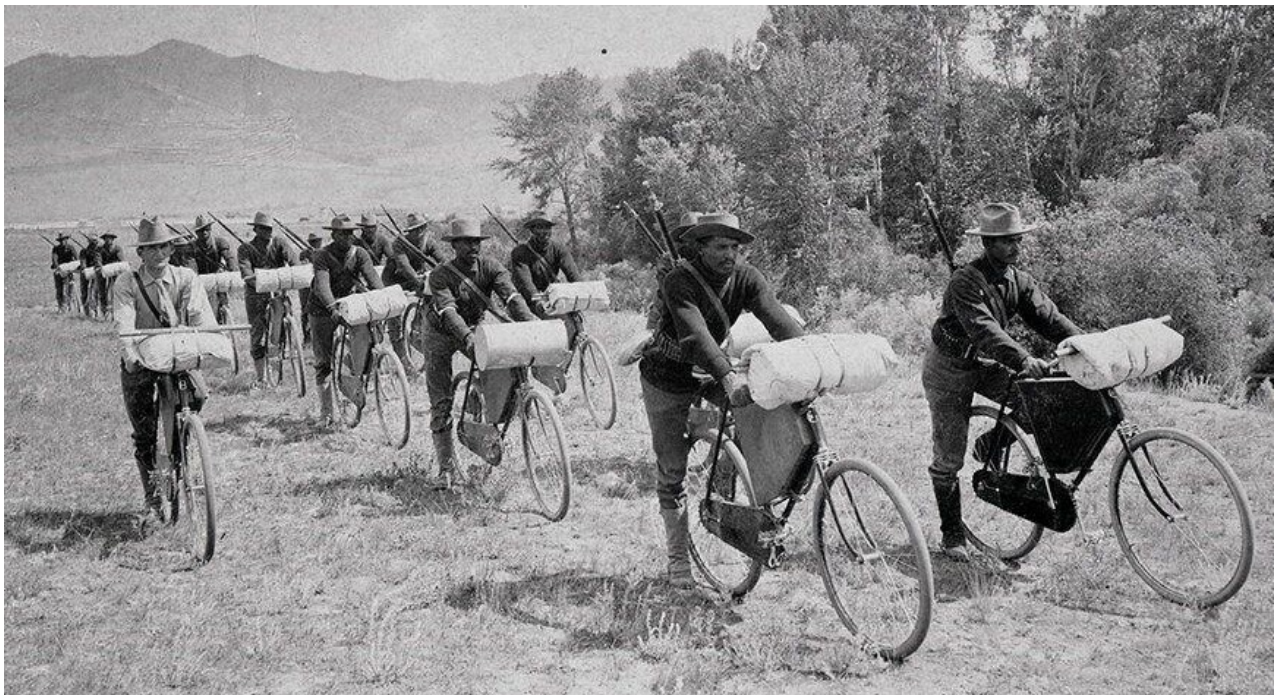


The 25th Infantry in Yellowstone, 1896

The military's intent to "thoroughly tested under all possible conditions (Fortmissoulamuseum.org, 2022)" kept these riders off-road for the overwhelming majority of these trips, encountering the harshest of conditions including extreme heat and cold, as well as mud and snow.

These riders were unsupported and carried all the essential gear on their bikes, as was noted by an article published by Fort Missoula Museum:

Each bicycle carried a knapsack, blanket roll, and a shelter strapped to the handlebar. A hard leather frame case fit into the diamond of each bicycle and a drinking cup was kept in a cloth sack under the seat. Each rider carried a rifle (first slung over the back, later strapped to the horizontal bar) and 50 rounds of ammunition. (Fortmissoulamuseum.org, 2022)



The configuration of equipment in 1896 shows similarities to contemporary configurations

Following the 25th Infantry's journey, the next recognizable nexus of off-road cycle touring and possibly its genesis as a recreational sport, happened somewhere near the English and Welsh border with the inaugural meeting of the Rough Stuff Fellowship (RSF) in 1955. This cycling group's stated goal was to ride "the rougher and less-beaten ways (Pidd, 2019)." This desire would take its members on the first unsupported ride across Iceland and through the mountains of Tibet on their English-style touring bikes.

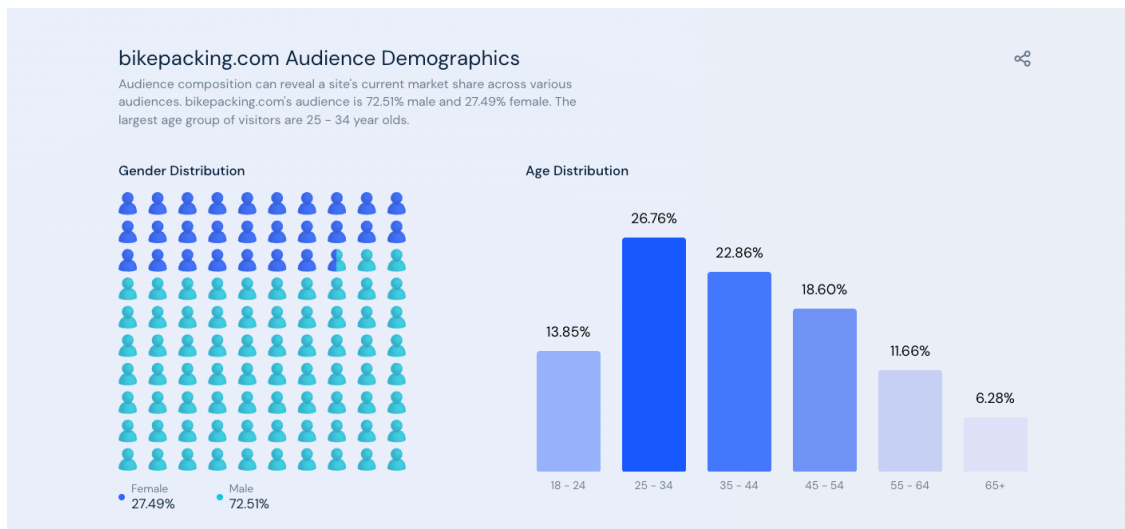


From the RSF photo archives

It wasn't until 1975 that the term bikepacking was coined by Dan Burden in his May 1977 article for National Geographic titled *Bikepacking Across Alaska and Canada* that detailed a primarily off-road 3000-mile journey undertaken by four riders, two women and two men including Burden himself (Simplicityvintagecycles.com, 2012).

### User Focus

Design research for this project will focus primarily on experienced male identified and non-binary athletes, aged 18 to 55. While bikepackers are a diverse population of individuals of many genders, ages, and identities, an analysis of internet traffic on major bikepacking sites shows that the majority of interest in this sport is shown by individuals in this demographic.



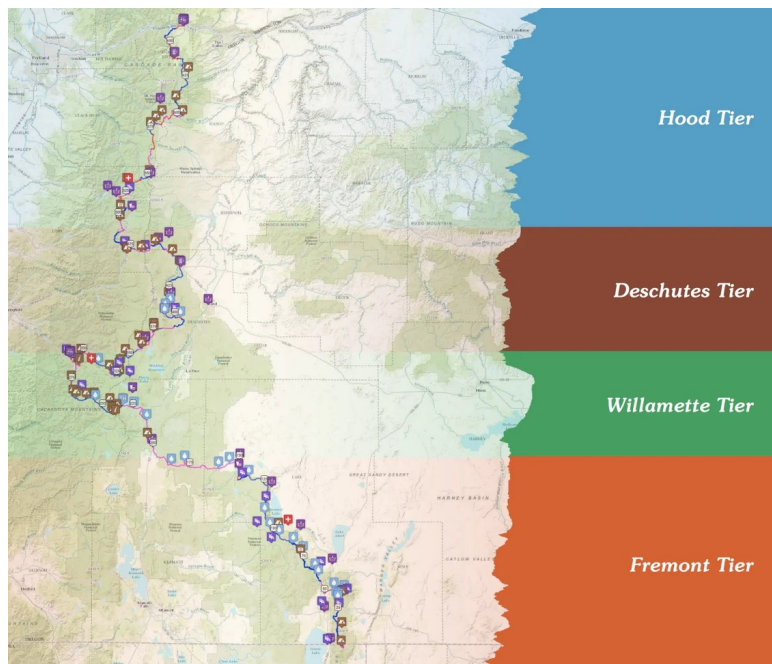
Statistics and figures from Similarweb.com

Additionally, due to the location of the author and his access to testing populations and routes, the primary focus of the design research will be on users in the Pacific Northwest.

Considering this user group, internet traffic statistics from bikepacking.com, one of the main sources of bikepacking news, reviews, routes, and editorials, were studied to develop an estimate for the potential user base of these products. The number of unique visitors to the site for July-September 2022 was multiplied by the percentage of unbounced visitors (the number of visitors not leaving the site after a single page view), then multiplied by the percentage of domestic visitors, and then finally multiplied by the percentage of male visitors resulting in approximately 69,000 potential users (Similarweb.com, 2022). This number was cross-referenced by examining the number of subscribed viewers to bikepacking.com's YouTube channel which was 78,000 (Youtube.com, 2022). Drawing upon both of these sources, as well as accounting for non-subscribing YouTube viewers and users visiting the site before July produce an estimate of between 70,000 and 80,000 users.

### Environment

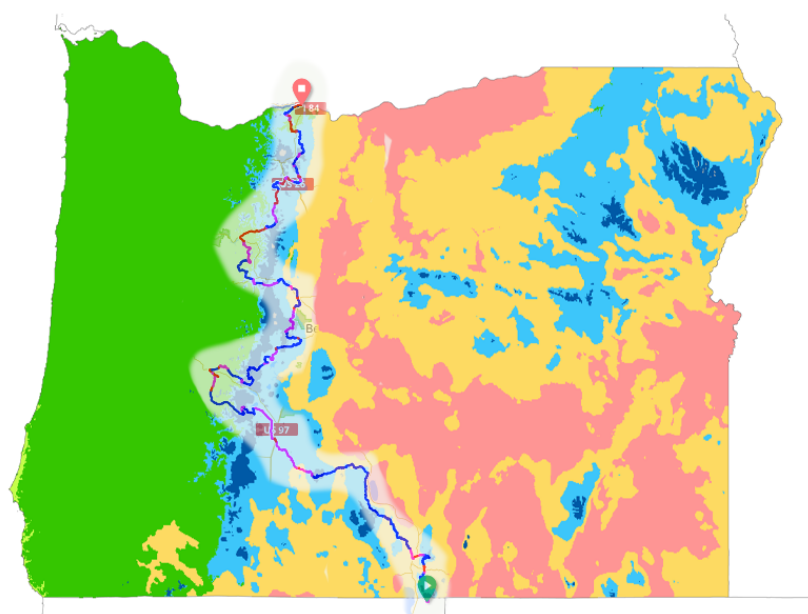
As mentioned above, the specific users of the equipment and apparel being designed will be domestic users in the Northwest. All though there are many bikepacking routes in the Northwest corner of the United States, there are perhaps none that offer as challenging and diverse terrain, or as lengthy an endeavor as the Oregon Timber Trail (OTT). These attributes make it a perfect candidate for designing equipment that provides for these user's needs.



The four tiers of the Oregon Timber Trail presented in the initial press release for the route (Oregontimbertrail.com, 2022)

The OTT is a 670-mile route that is 90% unpaved, boasts 51% single-track riding, and 69,283 feet of elevation gain (Amadeus, 2022). The OTT is broken into 4 “tiers”; the Fremont Tier, the Willamette Tier, the Deschutes Tier, and the Hood Tier. Each of these areas has its own particular climate, geology, flora, and fauna, resulting in particular challenges to the rider when passing through each of these regions.

### Trewartha climate types of Oregon



#### Trewartha climate type

BS (Steppe)	Cf (Humid subtropical)	Dc (Continental)
BW (Desert)	Do (Oceanic)	E (Boreal)
		Ft (Tundra)

\*Highland climates omitted, following Belda et al. 2014

Data sources: Köppen types calculated from data from PRISM Climate Group, Oregon State University, <http://prism.oregonstate.edu>; Outline map from US Census Bureau

OTT route crosses through 4-5 different Oregon climates. An overlay of the OTT route (Oregontimertrail.com, 2022) and an Oregon climate types map (Wikiwand.com, 2022)

Due to snowpack, the route is generally only rideable in its entirety between late June and mid-October. Additionally, a large portion of the route sits above 4500' resulting in earlier snowfall and later thaws than elsewhere in the state and riders should expect below-freezing temperatures during the night at higher elevations throughout the riding season. However, during the summer months, temperatures reaching 90° are likely, particularly in the southern part of the route (Oregontimbertrail.org, 2022).

While on the route, there is a high likelihood that the rider will encounter extreme precipitation and an extreme lack of precipitation. For instance, a rider on the route in June of 2020 would have passed through areas that would have received no rain for the entire month and areas that would have seen as much as 6”-8” of rain (NOAA,

2022). These extremes of both precipitation and the lack thereof provide an extreme challenge to both the rider's apparel and equipment.

Riders on the OTT will find themselves on many different types of surfaces as well. As indicated earlier, the OTT consists mainly of single-track trail riding. Due to the large variants of climate type and weather conditions, these trail surfaces can present as dry and dusty, slick and muddy, hard packed, gravelly, rocky, and rooty. While on single-track, riders should also expect to encounter small water crossings to ride through, fallen trees requiring the riders to lift their bike, and, depending on the time of year that they have chosen to ride, the potential to encounter snow at higher elevations.

The OTT route consists of just over half single-track riding with much of the rest consisting of gravel and double-track roads. Some of these roads are maintained regularly, while other may be washed out or extremely muddy. Riding on double-track and gravel roads holds almost as much potential for variability as single-track riding on the route.

Interactions with flora and fauna also represent environmental challenges to riders. While interactions with black bears and mountain lions are possible on the route, they do not represent a major risk to riders. However, mosquitos represent a major nuisance to riders, particularly during the early part of the riding season at higher elevations (Oregontimbertrail.com, 2022). Interviews with athletes who had completed the route revealed mosquitos to be among their primary concerns and that the tenacity of these insects required riders to cover their skin at all times.

### **Responsibilities and Rules for Bikepackers**

Considering the prevalence of messaging, editorials, and other media on major bikepacking websites providing instructions on how to bikepack *responsibly*, it is clear that the bikepacking community cares deeply about this issue. For these athletes, responsible bikepacking requires an understanding of the conservation of the land, as well as knowledge of safety procedures, and knowledge of how to minimize risk to themselves and the land they interact with.

Ideas about public land conservation, stemming from the popular Leave No Trace(LNT) approach to public lands, appear on Bikepacking.com and other sites that provide bikepacking content, like theradavist.com. Bikepacking.com has developed what it calls “(a) vision for bikepacking-specific LNT principles” called “Ride. Camp. Respect (Watts, 2022).” This principle and the accompanying editorial used by the site to introduce it, highlight some of the classic ideas of LNT and even extends those ideas, encouraging bikepackers to “leave it as you found it, or better.” The article gives tips and links to other articles on the site giving advice to bikepackers on practices to limit their environmental impact. These tips include encouraging riders to understand land designations, insights for determining the best time and weather to ride to limit impact, how to plan meals to avoid the use of disposable packaging, how to camp and set up a tent to avoid environmental impact, how to deal with human waste and personal hygiene and what environmentally friendly soaps to use, how to camp without using potentially damaging campfires, how to properly perform a bear hang and avoid negative animal interactions as well as many other tips.

This same editorial on bikepacking.com encourages bikepackers to engage in the social and cultural conservation of the land. They particularly encourage bikepackers to be aware of the land as the historic and current home of indigenous peoples and the impact of colonization. Logan Watts, founder, and head of Bikepacking.com highlighted the precedence this issue should have for bikepackers in his Ride Camp Respect article:

Take the time to learn about the history of the land through which you're traveling. In particular, familiarize yourself with its Indigenous history and the traditional stewards of the land. We added land acknowledgments to our entire archive of North American bikepacking routes, and we believe this layer of knowledge adds depth to any place. It also offers a profound perspective of a place's importance, the naming of geographic entities, the interconnectedness of natural and cultural history, and other crucial aspects about a place that we should all aim to recognize and respect as we travel through it. (Watts, 2022)

Other social issues are also addressed in the article, encouraging bikers to be friendly to other trail users, to be respectful of local customs, particularly when passing through rural communities, and to act as the best representative of the bikepacking community at large. The importance of both cultural and natural conservation of the land and the impression of their interconnectedness, as presented by Watts above, is clearly paramount to the bikepacking community. Bikepackers purchasing apparel and equipment will want products that support these values. Thereby, the design of such products must include considerations for the values to be successful.

As it is not the author's intention to design equipment specifically for racing the OTT, there are no specific rules that limit the design of apparel and equipment for the intended user. However, a race of the OTT, The Timber Trail 700, is organized every year. The organizers intended the event to attract "a healthy mix of serious competitors, not so serious but still sorta competitors, and folks who just want to ride their bikes and party with friends (Oregontimbertrail.com, 2022)." The race does have specific rules governing riders and what constitutes successful, safe, and respectful completion of the event. These rules are intended to apply to both competitive and non-competitive racers and it is the author's belief that these rules would act as effective guidance for any rider on the OTT. The rules for the Timber Trail 700 are as follows:

If you are considering the OTT700, the challenge is completely self-supported; there is no entry fee, no aid-stations, and no prize money. Bikepacking at its finest.

#### Summary of the Rules:

The Timber Trail 700 is similar to the Colorado Trail Race, the Arizona Trail Race, the Tour Divide and numerous other self-supported bikepacking events. The organizers will provide a route description, GPX track / map, start time and a document all finishers of the full route. Riders can be viewed through the Trackleaders system on line.

#### Self-Supported:

- There will be no organized aid stations of any sort
- Pre-arranged meetings, caches, support crews, pacers, etc. are not allowed
- Do not expect trail magic out there!
- Sections are remote, be certain you are prepared and can self-rescue
- To be considered a finisher, you must complete the full route under your own power
- Although not required, all riders are highly-encourage to register a SPOT GPS Tracker for the event page

#### Respect the Community:

- Do not break the law
- Be courteous to all trail users and use proper etiquette at all times (ie. yielding to other users, obey traffic laws etc).
- The OTT700 will not accept any rider actions that may jeopardize future events
- Speak up if someone is acting out of line, the Oregon Timber Trail is an asset to our communities and we are all responsible for it
- Wear lights while riding county roads at night

#### All are Welcome

- We are committed to deep and enduring friendships and partnerships that advocate for equitable treatment and elimination of discrimination in all its forms within our organization and within communities along the trail
- We want your help welcoming people from all backgrounds and abilities to ride or race the OTT
- Any disparaging remarks, racism, misogyny, or otherwise being a jerk will result in you being asked to leave and your results nullified

#### Stay on Course:

- Follow the full track or designated detours of any sort
- Utilize only commercially available services available to all riders on the route
- If you deviate from the course and choose to continue, you must re-join at the exact location of your departure to be considered a finisher

#### Leave No Trace:

- **MOST IMPORTANT:** Minimize your impact to the environment and be diligent with Leave No Trace Principals.
- All racers and riders must be experienced backcountry travelers and understand their responsibilities
- The rules for the Timber Trail 700 are intended to be simple and concise for all participants. Ultimately, it's up to each individual to complete the route under their own power. Whether you are trying to set the Fastest Known Time or simply finish, respect the rules of the event, the other riders and the trail itself. (Oregontimbertrail.com, 2022)

Besides the sections pertaining to the definitions of self-supported racing and instructions for staying on course, the majority of the rules presented above are intended to direct the racer's behavior to encourage personal responsibility and safety, to create a welcoming and respectful social atmosphere for the racers and the people they encounter, and most importantly limit environmental impact. These rules directly reflect and codify the importance of the responsibilities presented above, demonstrating their importance to competitive and non-competitive athletes attempting the OTT and the bikepacking community at large. That said there is little that directly dictates the design and construction of apparel and equipment for the OTT. If anything these rules and responsibilities encourages the design of apparel and equipment features that facilitate preparedness and safety and the use of materials that limit environmental impact, both in their creation and use.

### **Positions**

An athlete on the OTT will find their body in many positions. In total, the amount of time any rider actually spends sitting and pedaling their bike is relatively small. As Neil Beltchenko notes on Bikepacking.com's YouTube channel, “one of the most important parts of bikepacking is the time at camp and ultimately in your tent. Oftentimes, you will spend more time sleeping than riding (Bikepacking.com, 2022).” If the time spent in a position was to be considered the most important metric of its importance, then laying down would be the most important position in bikepacking. Certainly, well-spent time in camp is critical to the successful completion of the OTT. Besides sleeping, camping activities also include preparing and eating food, prepping for the next day's ride, and socializing with other riders. During this time riders may find themselves squatting, sitting, or kneeling to cook, eat, wash clothing and cooking utensils, and of course, lying down to sleep.

When the athlete is *riding*, being actually on the bike constitutes just one of several possible positions in which they will find themselves. The OTT also requires riders to push their bike through unrideable sections of the route, an action commonly known as hike-a-bike in the mountain biking and bikepacking communities. In fact, bikepacking.com only rates the route as being 90% rideable, meaning athletes may end up pushing their bikes as much as 68 miles over the course of the entire route (Amadeus, 2022). As mentioned earlier, athletes attempting the OTT will also need to lift their bikes over many fallen trees that have crossed the trail, particularly on less often maintained parts of the route.

Documenting rides is also a large part of the bikepacking experience. Riders often bring digital or film cameras and will pause either straddling the bike, or standing trailside to take photographs.

Bikepackers will also regularly find themselves sitting, squatting, kneeling, or standing trailside to rest, eat snacks, urinate, defecate or perform maintenance or repairs on their equipment.

### **Biomechanics**

Considering the many body positions used by a bikepacker on the OTT, equipment and apparel design for bikepackers must also consider biomechanics. Riders will be on their bikes for long amounts of time each day, so considering cycling

biomechanics is critical. Of particular concern for apparel design is lower joint mobility. Current biomechanics estimates for knee flexion during pedaling are 75° and about 25°-35° of sagittal plane motion for the hip (Wadsworth and Weinrauch, 2019). However, this estimate was derived from properly fitted road cyclists and doesn't take into account the additional mobility required by contemporary mountain bikes that are the most popular for the OTT. The common use of dropper seat posts on contemporary mountain bikes adds as much as 180mm of on-the-fly saddle height adjustability allowing riders to lower their center of gravity and more easily maneuver the bike during technical downhill riding. The use of dropper seat posts would increase the amount of flexion and movement for both the knee and hip joints compared to those of the road bikers in the previously referenced study, however, using these estimates for joint mobility would provide an acceptable baseline for the minimum of articulation in bikepacking specific bottoms.

As hip packs are part of the planned line, a biomechanical understanding of the effects of carrying a load with a hip belt should also be understood. Current research in this area is mostly concerned with hip belts as additional load-spreading features in backpacks. The load weights used in these study was much higher than would be found in hip packs for bike packers. Encouragingly, the study has concluded that even high-tension hip belts have little if any impact on the hip joint's range of motion (Oberhofer, 2018).

### **Physiology**

Bikepackers on the OTT route are likely to be affected by a number of physiological factors, many of these being the result of the environment while others are a result of their change in lifestyle. Of the environmental factors, the likelihood of passing through both extreme heat and extreme cold, as well as general thermoregulation should be considered of great importance for the design process.

Heat has been shown to dramatically affect the performance thresholds of any athlete, causing increased cardiovascular stress, resulting in “a rise in heart rate that is disproportional to the absolute intensity (of the exercise) and resulting in diminished aerobic capacity and performance (Wingo, 2014).”

Prolonged exposure to cold also has performance drawbacks for the athlete. A common reaction to cold is shivering and vasoconstriction which are responses that are beneficial for a cold athlete, but prolonged cold exposure while exercising “can impair peripheral vasoconstriction and shivering, leading to increased fatigue and reduced exercise capacity (No and Kwak, 2016).” Bikepackers are especially susceptible to these effects when dealing with windchill experienced during longer high-speed descents.

Other physiological concerns are the result of the change in lifestyle. With decreased access to reliable water sources on many parts of the OTT, the ability of the athlete to wash apparel or even bathe is greatly reduced. A regular side effect of cardiovascular exercise is the production of sweat, which when left unwashed for days at a time can increase the chances of chaffing, as the result of the formation of salt crystallization from evaporating sweat on apparel, and other skin-related maladies including sweat dermatitis, as well as bacterial and fungal infection (Soni et al., 2019). Some studies have even shown a possibility that endurance exercise may make the

skin more vulnerable to infection (Eda et al., 2013). Additionally, the nature of long-distance cycling has been shown to cause many other non-traumatic injuries including, buttocks pain, neck and shoulder pain, knee pain, skin ulcers, as well as palmar pain or paresthesias, and groin numbness (Weiss, 1985).

### **Psychology**

The transformative nature of bikepacking has been noted with regularity throughout this paper. The change in lifestyle inherent to participating in this sport will have psychological effects that must be considered. Thankfully, being in the outdoors and spending time in nature have been associated with positive outcomes for mental health (Coventry et al., 2021). However, with the length and challenge of a bikepacking route like the OTT, psychological challenges for the athlete will surely arise.

Of particular importance to successfully completing the route is good recovery, which also necessitates quality sleep. Sleeping well will require the athlete to trust the security and weatherproofing of their tent, while also feeling comfortable inside it. Tent anxiety is a phenomenon that is reported with some regularity and should be considered in the design of a tent. There are many causes of tent anxiety including feelings of a lack of security from dangerous animals or other intruders, unfamiliar sounds, unfamiliar sleeping environments, and claustrophobia (Kerby, 2020). Sleep has been shown to be a key component in the performance of athletes (Vitale et al., 2019). Sleep hygiene and quality sleep should be encouraged by tent design.

### **User Research Methods**

The primary means of gathering additional data will be athlete interviews. It is the author's belief that a more nuanced understanding of users' needs can be gathered through interviews. Interviews, unlike surveys, leave room for further exploration of questions asked of the target users, allowing for a greater depth of understanding (Milton and Rogers, 2013). The author has prepared a short list of questions to guide the interview. These questions are purposefully constructed to allow the interviewee to answer in any way they see fit, allowing room for storytelling, passionate opinions, and greater insight. The prepared questions are as follows:

- Do you have a picture of the items you packed or a pack list?
- What was the worst weather you encountered on the trip?
- What are your most important considerations when purchasing gear other than cost?
- What kind of shelter did you use?
- Did you break or tear any apparel or equipment other than your bike?
- Did you feel like your equipment or apparel worked well in certain situations but not in others?
- Were there times when you wished you were able to cover your bike while you slept?
- Did you carry a camera?
- Did you carry separate clothing for camp and riding?
- What's your favorite piece of equipment or apparel for bikepacking and why?

In addition to interviews, the author will also attempt the “try-it-yourself” method by bikepacking certain segments of the OTT or similar trails, depending on the season and the snow and weather conditions on the OTT during the assigned research time. This process is encouraged because it gives “ a deeper awareness of the multifaceted experiences the actual end-users (will) encounter (Milton and Rogers, 2013).” The understanding gained by this method will be essential to gaining a better understanding of the transformational nature of the sport, allowing for insights that would otherwise be missed by other research methods.

### **Athlete Insights**

Interviews were conducted using the methods and questions specified above. Three athletes were interviewed. They were between the ages of 25 and 35 and were found through their use of the *#bikepacking* tag or the *#oregontimbertrail* tag on Instagram. Two of the athlete raced the Timber Trail 700 in 2021. Another athlete was interviewed for his particular insight into carrying a camera while bikepacking, although all athletes reported taking many pictures when bikepacking.

Particularly informative quotes are included below and are grouped based on the sorts of insight they provided. Some quotes have been paraphrased for clarity. Many of these quotes could fit into multiple categories.

#### **Environment**

“Smoke mitigation and sun protection were things we were always obsessed about on the route.”

“Especially in (the high elevation sections) there was a lot of water crossing and standing water you would be on and off your bike a lot and there were so many bugs”

“I think the hardest things were the heat, the smoke, and the lack of water. At certain points, we were digging seep holes for water.”

“It was hot as hell most of the time”

“The mosquitos were crazy. I’ve been to Alaska in the summer and this was worse.”

“The type of trail it is, you can pretty much pull over wherever and camp.”

“The elevation can catch you off guard sometimes with cold temperatures.”

#### **Equipment or Apparel Strengths**

“I had a whole mosquito net shirt with a hood and that was one of the most important pieces of gear that I had. - I wasn’t just wearing that in camp. I was riding in that. - It was the number one piece of gear that other riders and people commenting on my (instagram) post would say ‘I wish I had that or I could have used that at x-y-z place’”

“Everyone was riding with n95 mask in the smoke”

“The nice thing (about Kitsbow clothing) is that it might be expensive to buy but you have it for the rest of your life. That’s not really the case with most outdoor gear”

“My number one strategy for sun and bugs is to use long sleeves and cover up with fabrics instead of relying on chemical defenses.”

“I feel like having full tent coverage really helped with staying warm at night.”

“Having some barriers when sleeping can help to feel more secure. I mean I have a bevy set up, but trying to get to sleep with the mental hurdle of the idea that a coyote might be right in my face sniffing me while I sleep is kinda scary.”

“On the OTT specifically, parts of that route are so remote that you’re just *out there*, and on the one hand, you can get used to it pretty quickly, but it can be nice to feel like I could cozy up into something and that I wasn’t just flopping over on the ground.”

#### **Equipment or Apparel Weakness**

“That mosquito net shirt, because of the way it was designed, would snag on trees and beaches when I was riding on single-track. It wasn’t really conducive to that, but it was also super necessary.”

“The Mindshift backpack zipper sucks. It’s too small of a gauge and it’s not smooth.”

“I hate bikepacking with a backpack. I don’t like wearing a backpack when I don’t have to. I get sweaty.”

“Avoid zippers if you can. I break zippers all the time.”

“Double-wall bathtub floor tents can also hold water in. On one trip my partner and I got absolutely f\*\*\*ed by rain. And we probably bailed a gallon of water out of the tent and there were still pools of water sitting in the tent. We would have been dry and comfortable if we would have had a pyramid-style tent. We would have had it set up in two minutes.”

“I like the idea of waterproofing but if you put something wet in a waterproof bag then it stays wet and doesn’t dry out and gets really gross. If things can dry out while you’re riding, that’s better.”

“The mosquitoes would bite through my gloves.”

#### **Equipment or Apparel Desires**

“Super durable s\*\*\*, that’s what would appeal to me. It might weigh a little more but it will last forever.”

“I had this handlebar bag from Bedrock that I modified with a strap I added. I essentially made it so I could loop it through my two front belt loops and then clipped it up front so the pack should slide on the strap itself and that worked really well because it was at belt level and it didn’t interact with my shirt and it wasn’t the whole strap sliding it was just the pack sliding independently of the strap.”

“Being able to have padding, some form of rigidity, and some sort of modular dividers would be really nice.”

“My current pads that I use for my knees are xxxl troy lee designs *elbow* pads and I like them because they’re super minimal and flexible, they have mesh - good venting on the back of my knees, they’re really lightweight and they’re a little longer than a knee pad so they protect my shins.”

#### **Adaptability and Weight and Volume**

“I feel having versatile things allows you to carry less and I feel like that was my one big takeaway from that trip. That carrying less weight is important because the riding is so taxing and technical and there are some really long days. The more single items that you can bring that serve multiple purposes the better, even if you sacrifice comfort or convenience.”

“In bikepacking we’re trying to use every little square centimeter of space.”

“Modularity is sweet. Being able to optionally add little pouches or water bottle holders to the outside of it would be sweet.”

“Mosquito head nets are great and they don’t take up any room.”

“I had a full change of merino base layers.”

“I wore a sun hoodie for most of my days on the trip and I was really glad that I had that because it protected me from the sun and the bugs.”

“A place to gather and eat together would have been nice in an ideal world, but carrying something like that with the weight penalty and the logistic of setting up and tearing down a structure like that would be too much.”

“I had riding clothing and camp clothing. Hygiene is really important to me on a trip like that. I don’t want to continue wearing something gross and dirty in camp.”

“One direction I think a designer could go with knee pads would be to have like a super lightweight pad built into a merino leg warmer that you could ride in but also wear around camp and kneel down next to the fire or do other things like that.”

#### **Adaptability and Time**

“There a lot of adaptation. I feel like that’s the biggest thing. You have to be adaptable because things change really fast.”

“I modified (my camera bag) to not use a zipper - to use a big Velcro rubberized strap to make it easier to open - to get my camera out on a ride when I really wanted it quickly.”

“Quick access (to cameras) is definitely important.”

“I use the Mindshift backpack and it has a hip pack that flips around really quickly, which is nice, and I like that because it keeps the weight low.”

“If you could find a way (for hip packs) to solve the problem of (layers of clothing) bunching up and still be able to quickly flip (the hip pack) from your back to your front that would be huge.”

“I feel like having things that can withstand different microclimates and situation is really important because the amount of variants in the environment on that whole trip is so insane.”

“The less you can stop the better, so having lots of pockets on bottoms is helpful”

“Tents can feel really cumbersome to set up and take down when you’re tired.”

“Having some way to filter water that feels efficient, or sometimes I want to be filtering water in my tent, like hanging a gravity filter system in my tent would be really nice”

#### **Fit or Aesthetics**

“I think that most mountain bike apparel looks like s\*\*\*. All the shorts are still too long.”

When asked about their favorite riding shorts “They’ve got a good amount of stretch, but they don’t stretch out. They’re short! Which is what I like about them. They’re not the weird mountain bike-length baggies.”

“The Pearl Izumi Rove shorts are my new favorite shorts. They’re a little bit stiffer fabric. They fit just above the knee. They’re kinda fitted, kinda like tight “dad” shorts. And they’re a little thinner than jean shorts, which is nice because they’re not as hot.”

#### **Jobs to be Done**

The research presented above shows the many and varied needs of these athletes dictated by environmental conditions both natural and social, and those insured by a change in lifestyle. Ideally, an athlete on the OTT could bring any number of pieces of apparel and equipment with them to perfectly satisfy their needs for any given scenario they encounter. Unfortunately, the athlete’s capacity, in terms of both weight and volume, is limited. In their introductory bikepacking article, [Bikepacking 101](#), Bikepacking.com relates the importance of minimizing weight:

A lightweight setup is certainly the goal to aspire to. The lighter the load, the more you'll enjoy the ride. A lighter rig is also easier to handle on technical single-track and to carry across sections of trail that may prove unrideable. (Bikepacking.com, 2022)

Additionally, an average bikepacker only has access to 35-50 liters of storage volume (Codey, 2020). This means that the athlete must choose the most appropriate equipment that is either versatile or can adapt to many different needs.

As the research above has shown, apparel and equipment jobs to be done include thermo regulation for both hot and cold temperatures; protection from mosquitos, and sunburn; protection of additional equipment like cameras; sweat, chaffing, irritant, and pathogen management; providing for a range of motion for arms and legs; as well as safety, respect and adherence to LNT principles. Many products on the market are capable of doing one or two of these jobs. Some products are versatile enough that an athlete may be willing to use them as a compromise. However, there are no products that are intended to allow a bikepacker to easily adapt to the extreme diversity of possible jobs to be done while completing the OTT. The key jobs to be done by apparel and equipment for these athletes will be to increase their ability to adapt and to reduce or at least not increase the weight they are carrying.

### **Problem Statement**

Bikepacking's transformative effect on the athlete's entire lifestyle while engaged in the sport, as well as the diverse climates and environmental factors specifically encountered by an athlete on the OTT route, necessitate providing for varied, and at times conflicting user needs. To create the best possible products for the target user, design research and resulting design goals must be adaptable. That is, all aspects of the athlete's engagement in the sport must be considered, not just the time they spend riding. To this end, the following question has been constructed to guide the design of apparel and equipment for athletes attempting to complete the OTT: How could we design apparel and equipment that support bikepackers' ability to adapt to changing conditions on the Oregon Timber Trail?

### **Product Classification**

Men's apparel and equipment for bikepacking The Oregon Timber Trail.

### **Line Plan and Existing Equipment and Materials**

Considering the above design goals and the current market, the most crucial area for innovation in the apparel space is in bottoms, either shorts or pants. For equipment, there is particular room for innovation for tents as well as hip packs.

Of course, bike-mounted bags are crucial to bikepacking, and not including them in the above list requires addressing. There are many innovative companies working in this space, while the items mentioned previously are generally made without specific consideration for bikepacking.

For the most part, apparel used by bikepackers is designed as general cycling apparel and does not have features that provide for the athlete's needs when off the

bike. There are a few notable exceptions. One company offering a garment with the adaptability to offer performance features for riding and other activities is Elevenpine. They offer cycling shorts with their unique patented 11P® system which uses a zipper extending vertically from the waistband to the bottom hem allowing the user to expand and expose a poly tricot mesh dart. This feature lets the user change the fit from a tight performance-oriented fit to a loose casual fit (Elevenpine, 2022).



Figure shows the functionality of Elevenpine shorts (Elevenpine, 2022).

This feature isn't specifically aimed at the bikepacking community, but would certainly be useful for transforming one's apparel to be more comfortable and functional around camp. Besides this adjustable fit feature offered in their men's Uprising shorts, these shorts also offer 86% Polyester, 14% Spandex 4-way stretch material, and two zippered side pockets.

7mesh is another company offering what might be considered a bike packing bottom, the Glidepath pant, which they describe as "A light, trim fit bike pant with DWR that does double-duty as a walk-around piece on multi-day expeditions (7mesh.com, 2022)." Specific features that make this piece suited to a multi-day expedition are not specifically listed. Features include a 4-way stretch 85% nylon, 15% elastane with DWR body, hand pockets, two zippered side pockets, belt loops, as well as low profile locking waist adjusters, zippered fly with 7mesh branded snap closure, DWR finish, reinforced, articulated knees, the ability to accommodate knee pads a cuffed hem, and reflective details.

It's also worth noting that styling is important to bike packers as well. Lead editor of The Radavist( another website that offers bikepacking-related content), John Wattson noted:

Baggy, long, parachute-looking shorts are a bummer. In my attempt to find a MUSA, quick-drying, durable shorts I found the Ornot Mission Shorts and they quickly replaced my old go-to shorts. Sure, an 8.5" inseam might not look like

modern MTB apparel but I'd argue that's a good thing. Shorts are short for a reason. Otherwise, they'd be called "Longs". (Wattson, 2021)

Being less conspicuous can help a rider feel safer and allow them to more easily navigate rural communities during resupply. Watt notes in his previously mentioned "Ride, Camp, Respect" article, "clothing that passes without a second glance in one place may cause outright offense in others, making a massive difference to how you're perceived and received (Watts, 2022). Again the Ornot Mission shorts may not be a product pointed directly at mountain bikers, but their understated nature could be an appealing feature. The Ornot Mission shorts are made with a recycled 4-way stretch 95% Nylon / 5% Elastane, and feature an 8.5" inseam, full panel gusset for increased mobility, 4 Pocket construction, 1 rear zippered pocket for secure storage (Ornot, 2022).

The same lack of bikepacking-specific features remains true for the tent market. While there are a few tents that are marketed as being "bikepacking specific", most of these are simply repackaged backpacking tents with ruggedized stuff sacks with attachment points that allow them to be more easily stored on bike racks or mounted on bicycle handlebars. Both Nemo equipment and Sea to Summit offer tents that have been repackaged in this way.



Nemo Equipment Dragonfly 2p Backpacking Tent and Sea to Summit Telos Tr2 Backing tent above and their repackaged bikepacking alternates shown below

Nemo's bikepacking tent does distinguish itself in one way from its backpacking counterpart. The bikepacking tent is offered in "subdued colors and non-reflective materials allow stealth camping (Nemo Equipment, 2022)." Like the Ornot Mission shorts described earlier, being less noticeable can improve the athlete's sense of safety.

Both of these tents use popular contemporary tent materials, including aluminum alloy poles, POM and aluminum hardware, poly no-see-um mesh, 15d and 20d silicone coated nylon ripstop, and nylon coil zippers.

Hip packs are another common accessory used by bikepackers for reason best described in the following quote from a community written article reviewing 14 hip packs on Bikepacking.com:

Although most of us try and leave the backpack at home, there are definitely situations that call for the use of a small pack, or our personal favorite, a hip pack. For many of us, it's the perfect place to keep a camera at hand, a few extra snacks, or a lightweight layer and other handy items. Hip packs provide that little extra packing space without feeling cumbersome or restrictive, and won't irritate your shoulders or back after a long day of pedaling. Best of all, their size means they are difficult to overpack, unlike a backpack, so you can focus on riding and not your comfort on the bike. (Bikepacking.com, 2022)

Given that the hip pack offers many recognized advantages to bikepackers there are once again no products that attempt to specifically cater to the bikepacker's needs. In fact, the same article quoted above provides instructions on how to make a DIY padded camera case to go inside any of the bags that they review since none offer features specific to camera storage. Besides carrying cameras, the article that a hip pack's ability to carry a little extra water and valuables like passports, IDs, and cash or even a light rain jacket makes them essential for longer trips.

Roll-top hip packs do seem to be popular among bikepackers due to them being perceived as more durable, and one could argue that this durability is a bikepacking-specific feature. Out of the 14 bags reviewed in Bikepacking.com's hip pack review article, five had roll-top openings for the main compartment.

Rockgiest, a company that is celebrated in the bikepacking community for offering innovative new features in their line of bike frame mounted bags, makes one of the roll top hip packs reviewed in the article, The Big Dumpling. This pack features 6 liters of storage space, a roll-top/flap closure with no zippers to fail, seam-welded construction for a 100% waterproof bag, a bungee closure that doubles as a convenient layer stash location, an internal cell phone/wallet sleeve, removable plastic strap keepers to prevent hip straps from flapping in wind structured hip wings for optimal load carrying, MOLLE webbing along hip wings allows for the addition of compatible accessories, as well as front/bottom accessory loops for adding carry straps for layers, knee pads, etc., and closed-cell foam & 3D mesh back and hip padding (Rockgiest.com, 2022).

Another popular roll-top hip pack reviewed was Pack NW's Ridgeline Pack. Although not 100% waterproof this pack features a simple roll-top closure for durability, an expandable main compartment, an exterior zippered pocket, two interior pockets for smaller items, side compression straps for a secure fit, daisy chain loops for a water bottle holster (sold separately), and a lightly padded waist gusset (PackNW.com, 2022).

Another pack using zippered closer rather than a roll-top closer was Rapha's Trail Hip pack. This pack was not included in the same list from the review article quoted above, but this almost certainly wasn't due to its method of closure. In fact, Rapha's hip pack is well featured, including a form-fitting and breathable back panel that provides ultimate stability and comfort, adjustable waist straps provide

unparalleled locked-in fit, preventing the bag from bouncing around while moving through rough terrain, two external pouches for water bottles or other accessories with integrated mesh collar to ensure your cargo stays put on the trail, a 3L capacity for daily essentials, an external drawcord that can be used to secure a jacket and a front valuables pocket. The pack even received a nearly four-and-a-half out of five-star rating from customers (Rapha.com, 2022).

However, [bikepacking.com](https://www.bikepacking.com)'s hip pack review article notes that “all but a couple (of the packs reviewed) are made in North America” including the two previously referenced. Being made in North America, and the social responsibility implied by it, it was used in marketing material by both Rockgeist and PackNW. Interestingly, the “made in the USA” tagline was added alongside the regular functional feature list used by both companies for the description of their hip packs. Backpacking.com's use of country of origin as one of the main criteria for a hip pack to be included in their review article shows that the bikepacking community sees implied social responsibility as a feature of equal or possibly greater importance to functional features.

All of the hip packs mentioned above used closed cell foam padding and knit 3D spacer mesh for the wings and back, poly or nylon webbing, POM hardware, TPU or polyurethane-faced water-resistant nylon coil zippers, when zippers were present, and woven nylon binding. Popular body materials were X-Pac VX 21 or other composites with some composites allowing for heat welding or bonding.

### **Current Manufacturing Methods**

The primary manufacturing methods used in all the products present above are cut and sew techniques. Although it uses knit materials, even Ibex's Sun Hoodie uses cut and sewn panels in its construction. These garments use top stitched, flat feld and French seams. Heat-bonded seam taping was used in the production of the Helium Rain Jacket as well as all of the tents. Heat-bonding adhesives were also used in the construction of the Big Dumpling Hip Pack and the Trail Hip Pack. In these cases, seam taping and bonding was performed to improve the water proofing of the product. Additionally, heat-bonding adhesives may be used in the construction of some of the waistbands of the bottoms presented above. In these cases, heat bonding was used to improve the comfort and performance of the garment.

### **Product Anatomy**

A brief overview of the composition of the features of competitor products is presented above, but a closer inspection of the anatomy of each of these product categories and consideration for the jobs to be done for each of their common parts reveals more detailed insights into current design thinking behind these products.

Tents commonly consist of the following parts labeled in the figure below: The rainfly is intended to provide shelter from precipitation, as well as provide privacy, a sense of security, and in some cases provide camouflage. The canopy is used to protect the athlete from insects and partially protect the user from condensation that builds up on the interior of the rainfly. The poles support the structure of the tent. The entry provides a way in and out of the tent. The bathtub style floor separates the user and their equipment from the ground, reduces the effects of drafts under the rainfly, and is intended to keep water out of the tent. The stakes keep the tent pitched taught,



allowing water to easily flow down the rain fly and keep the tent in place in the event of high winds.

Mountain bike bottoms, including both shorts and pants, often are constructed as such:



The waistband is the main point of contact with the rider's body, keeping the bottoms in place. Additionally, it is used to protect the lower back. This part of the body is generally more exposed in the riding position and is vulnerable to debris and mud thrown up by the rear tire, particularly in wet riding conditions. The side adjustment helps the shorts to stay in place without the use of a belt. The fly assists in the donning and doffing process and also makes urinating a more convenient process. The pockets allow for the storage of small items and are sometimes also used to improve ventilation and thermoregulation. The gusset provides for a greater range of

motion and increased ease of movement. The body of the bottom's primary job is to protect the rider's legs. The hem determines the cut of the shorts and can be used to improve durability.

Hip packs generally include the following parts:



The back padding has two main jobs. First, to protect the athlete from hard objects inside the pack. Second, to provide ventilation between the pack and the rider. The closure allows for access to items stored inside the pack. The body of the pack keeps items inside, and depending on the materials used for its construction can also provide different forms of protection including padding for impact protection or waterproofing. The hardware is used for the adjustment of the waistband, donning and doffing the pack, compression of the pack load, and closure. MOLLE webbing is a common addition to many hip packs and allows for the attachment of accessories and lights. Binding is used to finish the pack, provide aesthetic touches, and improve durability. It can be applied both internally and externally. The wings spread the load of the pack onto the hips and improve the stability of the load.

### **Future Materials and Manufacturing Processes**

Materials innovation for bikepacking apparel should be closely tied to thermo regulation as well as waterproofing and breathability while keeping in mind the need for durability. Although there has been some use of waterproof breathable material for cycling jackets, there are fewer examples of their use in cycling bottoms.

Possible waterproof breathable material for the future of bikepacking apparel would most likely come from the technical textile manufacturers Gore-tex or Pertex. Gore, the producers of Gore-tex and other products, will soon be releasing a bio-based waterproofing breathable film to their product line (Coons, 2019). This more environmentally friendly material would likely appeal to the bikepacking community that has been shown to be motivated by environmental and land stewardship efforts.

Sew-free seam bonding may offer advantages for the future manufacturing of bikepacking apparel. Aside from offering greater waterproofing, lightness, and durability than traditional sewing, bonded seams also have less chance of chaffing, a

particular area of concern for bikepacking bottoms and bags worn on the body, like hip packs (Saha, 2018).

For equipment, composite textiles offer the greatest advancements in performance. For use in bags Challenge Sail cloths recently released EcoPak laminated woven nylon “absorbs 80% less moisture, and has better UV resistance and color retention than traditional laminated nylon (Challenge-outdoor, 2022).” In addition, it's made out of 100% recycled nylon offering greater appeal to the intended user.

### Possible Intellectual Property and Patent Infringement Risks

Some of the products reviewed above represent areas where there is potential for intellectual property infringement. Of these, Elevenpine’s system for fit adjustment represents the product that could potentially offer the most advantages to the problem space presented for apparel.

Patents for tents with specific applications to cycling generally use the bike as a support structure for the tent as pictured below (Fig.1 and 2). While these systems offer the advantage of sheltering the bike, they decrease the utility of both the tent and the bike by making them reliant on one another. However, the ability to shelter both the bike and the rider could certainly be useful on the OTT with the high possibility of precipitation.

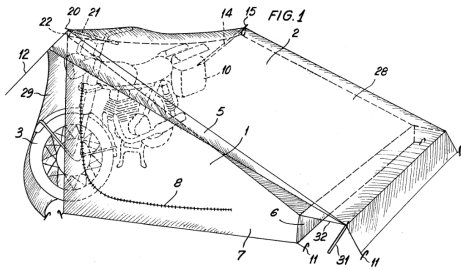


Figure 1 from patent #US4114633A

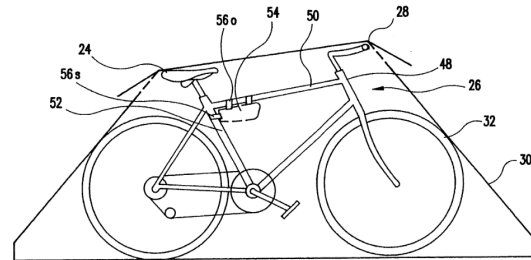


Figure 2 from patent #US5372156A

Patents do exist for hip pack innovations particularly relating to the easy access of a stored camera. One such system highlights the importance of quick camera accessibility that a hip pack can offer, but incorporates the pack into a backpack, including a “receiver” in the bottom of the backpack that the hip pack is able to slide out of for quick access (Fig. 3).

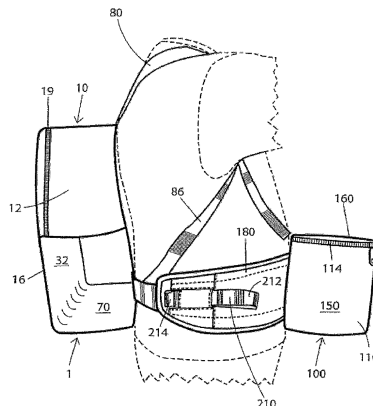


Figure 3 from patent #US8534523B2

As adaptability will be a chief concern of the design goals of this project, examining patents that try to address this concern for garments is crucial. Solutions to this problem using modular or “zip-off” are common in the industry. The use of some of these solutions is protected by patents. For tops, garment adaptability is primarily addressed through the addition of modular sleeves, generally consisting of a bolero-style modular upper that can be attached to a vest or shirt. Two different styles are pictured below (Fig. 4 and 5):

Generally, these patents differentiate themselves from each other by the attachment method. Attachment methods are also the main claim differentiation of patents for convertible bottoms as well.

### Existing and New Color Trends

The reality that there are few apparel products that have been produced specifically for bikepacking has already been well supported throughout this paper. Because of this, pointing out existing color trends for bikepacking apparel is difficult. For establishing a benchmark for current color trends in bikepacking, it is easiest to look at current colors used in bikepacking equipment. The most popular colors are earth tones, favored for the way they complement the surrounding environment or even allow for decreased visibility for stealth camping. Using color functionally in this way is even used as a feature in products, such as in the Nemo Equipment Dragonfly Tent presented above (Nemo Equipment, 2022). Other popular colors are derived from earth tones used in popular materials used for bikepacking bags such as those used in the popular X-Pac series by Dimension-Polyant. Due to the variety of bike frame sizes and shapes, many frame-mounted bags are ordered custom from cottage industry makers whose color choices are constrained to the mass-produced generic colors produced by Dimension-Polyant. The earth tones used in these materials are intended to appeal to many manufacturers, including manufacturers creating equipment for military and defense applications, and include colors like olive, ranger green, coyote brown, and dark brown.



X-pac and other materials advertised by Tacticaltrim.de, a supplier catering to the military and law enforcement.

Trends in cycling outside of bikepacking, and particularly the growth of gravel riding, will almost certainly have an effect on bikepacking consumer desires as new athletes enter the sport. The bikepacking community has noted with some frustration that the bicycle industry generally presents gravel biking and bikepacking as sports with a great deal of crossover or as extensions of one another. While the bikepacking community may see this as a misrepresentative marketing approach intended to drive the sales of gravel bikes, they also acknowledge that there is some degree of crossover and that “(gravel riding)’s gotten more people into riding on unpaved roads, bikepacking, and general dirt shenanigans (Watts, 2022).” For this reason, it’s reasonable to use gravel riding as a partial proxy for understanding future trends for color and graphic elements and patterns in bikepacking. One must still consider the

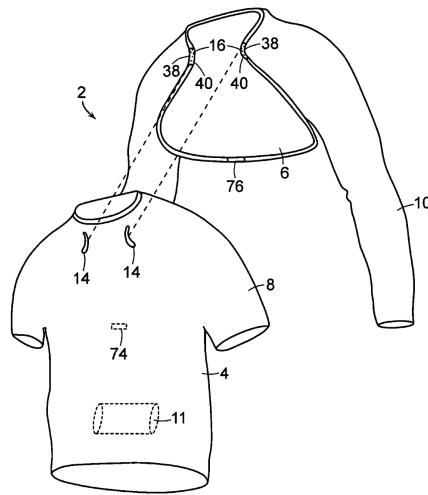


Figure 4 from patent #US7028342B1

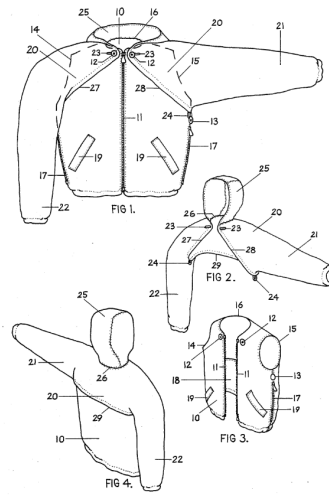


Figure 5 from patent #US4554682A

bikepackers specific needs for functional colors that complement their riding environment, in this case, the Oregon Timber Trail. The same growth in gravel biking noticed by Watts has also come to the attention of larger trend reporting and forecasting services like WSGN, who for the first time in 2022 offered trend forecasting, including color forecasting, specific to All-Terrain cycling for A/W 2023-2024 (Browning, 2022). Using this report, as well as WSGN core color long-term trend predictions for 2024 and beyond as well as colors from the Oregon environment, the author was able to construct a potential color trend pallet specific to the project (Kostiak, 2022)



### Existing and New Pattern Trends

Current and future trends for use of patterns for bikepacking are affected by the same factors as color trends. As with colors, available patterns in popular materials are often limited to patterns used by defense and military organizations, particularly Multicam and Black Multicam, pictured below:



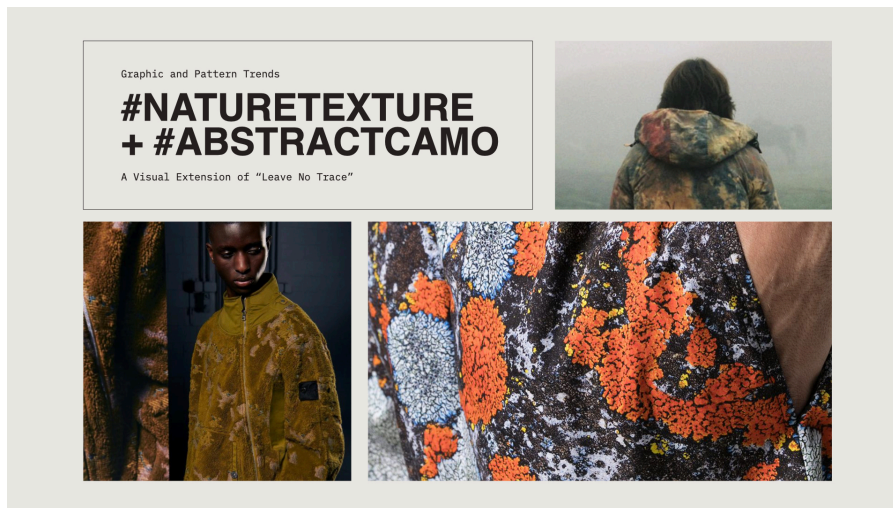
X-pac MultiCam



X-pac Black MultiCam

As with earth tones colors these camouflage patterns are popular within the bikepacking community due to their functional and stylistic attributes.

WSGN has cataloged the rise and development of the use of camouflage in recent years and in recommends that designers use abstract “camos and animal prints (to) create nature-inspired themes (Browning, 2022).” WSGN also notes the rise of botanical inspired camouflage and other natural textures for spring and summer fashion in 2023 and beyond (Zagor, 2022). Considering many bikepackers’ existing preference for camouflage patterns, growing trends and innovative ways of using camouflage patterns in contemporary fashion and the rich botanical landscape of the research environment, using camouflage could be very appealing to bikepackers.



## Branding

Like color and texture current branding trends in bikepacking can best be understood by looking at the bikepacking bag market. Popular brands like brands like Swift Industries and Ron's Bikes use branding that would best be described as “contemporary folk”. Their products, featuring their logos, are pictured below:



Swift Industries Branding



Ron's Bikes Branding

Cutting-edge branding trends within gravel cycling, previously established in this paper as a potential bellwether for trends in bikepacking, see these use of very simple text-based logos using sans serif grotesque fonts. Examples of these can be seen in the apparel lines of companies like Pas Normal, MAAP, and PEdALED none of which use any graphical elements in their logos.

Considering the success of brands like MAAP, with 42% YoY growth reported by WSGN, These simple branding strategies seem to be successful and will continue to be so (Kostiak, 2022). Alongside simplicity, WSGN suggests creating a sense of serene futurism or engineered nature which they also call out for working well alongside abstract camouflage patterns and natural textures like those mentioned above (Kostiak, 2022). Using simple graphic elements that suggest natural themes could accomplish these goals.



**DIRECT + SIMPLE BRANDING**

### **Innovation Opportunities**

The examination of the competitor products presented above provides a surface-level understanding of products in the market and certainly could be used as an initial starting point for innovation. However, for greater insight into possible opportunities, analytical tools should be used. One analytical tool, the SWOT chart, often used in business management, can be adapted to gather design insights. SWOT, an acronym for strengths, weaknesses, opportunities, and threats, provides a framework to closely scrutinize competitor products and is helpful in understanding what product features offer the most opportunities for the designer's innovation efforts. Presented in the tables on the following pages is a thorough examination of competitor products using this tool.

# ORNOT



MISSION SHORT  
\$118

Feature or part	Strength	Weaknesses	Opportunities	Threats
Waistband	Traditional waistband with belt loops can be used with a belt.	Using a belt with a hip pack is very uncomfortable	Integrate belt loops to work with a hip pack.	Customers may choose shorts with integrated adjustments that will work better with hip packs.
Body	Made with a fully recycled nylon four way stretch knit that moves with the athlete.	The material is not waterproof.	Could a stretch waterproof material be used instead?	Customers might choose waterproof bottoms over non-waterproof bottoms.
Fly	Uses a zippered and snapped closure method making bathroom breaks quick and easy	Button closure interacts particularly poorly with hipack straps.	Could the snap be eliminated to allow easy use of the fly without discomfort caused by the snap?	Customers might choose shorts without a button closure for use with a hip pack
Knee Area	Knee area is more exposed than other models offering high levels of breathability and has a more traditional aesthetic.	The shorter inseam offers less protection from the environment.	Could riding shorts be created that would allow for additional protection to be added?	Customers might choose shorts that offer greater levels of protection from the environment.

# POC



BASTION SHORTS  
\$200

Feature or part	Strength	Weaknesses	Opportunities	Threats
Waist Band	Built in rear pocket	Made of waterproof material that will hold in more sweat than non-waterproof material, especially right against the skin	Use more breathable material for the waistband.	Some consumers might avoid a waist band that they think might make them more sweaty.
Body	Waterproof and breathable keeps legs dry in rainy environments	Less breathable than shorts that don't use a permeable barrier	Use a more breathable material for body	Consumers might pick more breathable material shorts
Fly	Uses a zippered and snapped closure method making bathroom breaks quick and easy	Snap and possibly zippers could be uncomfortable when using a hip pack	Could the snap be eliminated to allow easy use of the fly without discomfort caused by the snap?	Some competitor product don't use a snap and a consumer might pick these to use with a hip pack
Knee Area	Shorts leave knees uncovered and free to move	Lower legs might get wet.	Could convertible pants/shorts be used to allow users to choose either or	Some consumers might pick zipoff pants for long bikepacking trips for the adaptability.

# 7MESH



GLIDEPTH PANT  
\$170

Feature or part	Strength	Weaknesses	Opportunities	Threats
Waist Band	Adjustable waistband allows for a perfect fit.	Extra hardware around that waist could contribute to the additional discomfort especially when being used with a hip pack	Could thinner hardware like aluminum g hooks be used in the adjustable waist band to reduce potential pressure points and discomfort.	Customers may choose a product that has less potential for discomfort.
Body	Nylon and elastane knit 4-way stretch with looped back yarns wick and stretch with the athlete.	Nylon and other synthetics can begin to smell after extended use without washing.	Could wool blends be used to reduce smell?	Customers may look for products that are better able to manage odor after many days of use.
Fly	Uses a zippered and snapped closure method making bathroom breaks quick and easy	Button closure interacts particularly poorly with hipack straps.	Could the snap be eliminated to allow easy use of the fly without discomfort caused by the snap?	Customers might choose shorts without a button closure for use with a hip pack
Knee Area	The pants are patterned with an articulated knee that is more comfortable for pedaling.	Pants might be too hot while riding the OTT	Is there a way to improve thermoregulation?	Customers might choose to avoid pants in favor of cooler options.



Big Dumpling Hip Pack  
\$175

Feature or part	Strength	Weaknesses	Opportunities	Threats
Waist belt	Wide nylon webbing offers even distribution of tension. Center POM buckle is easy to access	Buckle may dig in to user on the front of the stomach depending on trunk angle	Move hardware to side of body?	Some hip packs like the Dakine Helios SL move hardware to the side of the body for more comfort.
Wings	Large wings have ample surface area to keep load comfortable in place	Flat construction may not conform to the curved contours of the hips and cause discomfort	Could the wings be patterned or structured to better contour the hips?	Other hip packs use better contoured wings that might be more comfortable
Padding	Closed cell foam and 3d spacer mesh provides dual densities of padding for breathable comfort that doesn't hold in moisture.	Spacer mesh can slide against clothing allowing the pack to ride up.	Could a rubberized coating be used on the spacer mesh to ensure the pack stays in place?	Some packs don't use padding and customers might find it excessive
Main pocket	Bonded roll top main pocket is completely waterproof and very durable.	Roll top bags take more time to open and close.	Could the same level of durability and waterproofness be achieved with a faster open mechanism?	Some potential customers might be driven away by the high price.
Interior Pockets	There are minimal internal pockets allowing the user to fill the space in any manner they decide.	No camera pocket. This is one of the main reasons bike packers use hippecks	Could interior pockets be added to make camera storage less risky?	Other hip packs offer more secure storage for cameras.
Body	Tough heat bondable composite material	Probably difficult to reuse, repair and not env. friendly	Could a more environmentally friendly material be used?	Potential customers might look for more environmentally friendly options
Hardware	POM hardware is lightweight and allows for bendable clips	Breaks more easily than other hardware materials like aluminum	Could aluminum hardware be used instead?	Customers may want more reliable hardware than POM material can offer, especially for long bikepacking trips



Ridgeline Roll-top Hip Pack  
\$95

Feature or part	Strength	Weaknesses	Opportunities	Threats
Waist belt	Tried and true woven nylon webbing is durable and holds pack in place	Accessing the pack requires loosening the belt and twisting the belt around, which causes binding and twisting of clothing worn beneath the pack. Process must be reversed after done accessing pack	How can a hip pack be made to eliminate the need to loosen and retighten the belt for access.	Customer may choose a sling style bag that offers easy access but less support
Wings	Large wings have ample surface area to keep load comfortable in place	Flat construction may not conform to the curved contours of the hips and cause discomfort	Could the wings be patterned or structured to better contour the hips?	Other hip packs use better contoured wings that might be more comfortable
Padding	Closed cell foam and 3d spacer mesh provides dual densities of padding for breathable comfort that doesn't hold in moisture.	Spacer mesh can slide against clothing allowing the pack to ride up.	Could a rubberized coating be used on the spacer mesh to ensure the pack stays in place?	Some packs don't use padding and customer might find it excessive
Main pocket	Roll top closure is durable and allows for some expansion of load capacity	The expansion of load capacity doesn't allow the same capacity as a backpack	Small backpacks are considered essential gear by some riders on the Timber Trail, but many riders opt for a smaller hip pack for comfort. Could a hip pack turn into a backpack	Some riders may choose a backpack for the extra load carrying capacity
Interior Pockets	Has two interior pockets for smaller items.	If expandable main pocket is extended and filled it may be difficult to access interior pockets.	Could the interior pockets be placed in a different location to make them easy to access even when the main pocket is extended	Some customers may choose a smaller hip pack to guarantee easy access to all the interior pockets.
Body	Durable x-pac vx-21 will last a long time	X-pac is not made of recycled materials	Could a recycled material like Challenge Salicelli's Eco-pac EPA be used instead?	Customers may choose bags that use a more eco friendly body material.
Hardware	POM hardware is lightweight and allows for bendable clips	Breaks more easily than other hardware materials like aluminum	Could aluminum hardware be used instead?	Customers may want more reliable hardware than POM material can offer, especially for long bikepacking trips



TRAIL HIP PACK  
\$90

Feature or part	Strength	Weaknesses	Opportunities	Threats
Waist belt	Tried and true woven nylon webbing is durable and holds pack in place	Nylon absorbs more water than some other synthetics.	Use other synthetic webbing to absorb less water?	Some customers might seek out other hip packs with belts that breath more easily
Wings	Short wings contour around lower back more than entire hips, keeping pack in place with less material	Short wings may not offer enough comfortable support for larger loads.	Use additional padding around hips for more comfort	Other packs have larger wings with much more padding around the hips.
Padding	3D Mesh and closed cell padding has large passages to assist with breathability	Minimal padding may not be comfortable enough for heavy loads	Increase padding	Other packs have more padding against the back
Main pocket	Easy access zippered main pocket	Zippers are less durable than roltop closures	Could the same level of durability and waterproofness be achieved with the speed of a zipper?	Customers might choose not to buy this pack because of the zipper.
Interior Pockets	There are minimal internal pockets allowing the user to fill the space in any manner they decide.	No camera pocket. This is one of the main reasons bike packers use hippecks	Could interior pockets be added to make camera storage less risky?	Other hip packs offer more secure storage for cameras.
Body	100% recycled durable rip-stop Nylon	Not bonded so not completely waterproof	Could a recycled waterproof material be used instead	Customers might look for a bag that delivers fully waterproof storage
Hardware	POM hardware is lightweight and allows for bendable clips	Breaks more easily than other hardware materials like aluminum	Could aluminum hardware be used instead?	Customers may want more reliable hardware than POM material can offer, especially for long bikepacking trips.



Telos Bikepacking TR2  
\$649

Feature or part	Strengths	Weaknesses	Opportunities	Threats
Rain Fly	Can be used on its own in regular or chill out modes. Large vestibules on each side, very large vents, release condensation, can be set up independently or before the interior keeping the interior dry	Tension-ridge design depends on a single plastic part to support tent. Hang-out mode is susceptible to wind, large vents might let in precipitation	Eliminate interior walls all together	Single wall tents are lighter and offer similar functionality to just using the fly
Poles	DAC is a trusted pole manufacture and has brand appeal. Tension ridge system offers vertical walls better ventilation, Color coded for ease of setup	Segmented poles take time to put together	Could fewer poles accomplish similar goals?	Carbon or fiberglass poles might be lighter, single pole tents are faster to set up
Canopy/Walls	Tension ridge allows for greater amount of headspace, vertical walls are less claustrophobic	More material for head spaces means more weight, no-sew-um mesh is fragile	Can they be eliminated for less weight?	Competitors use mesh more sparingly, or single walls tents eliminate interior walls
Floor	Ripstop nylon is fairly durable, fairly light and moderately	"Bathub" style floors keep water in as well as they keep water out, doesn't drain well	Could be eliminated to increase drainage	Composites like dyneema offer better durability and are lighter
Hardware	Aluminum hardware use no moving or bending parts making it very durable, also eco friendly and recyclable	Aluminum can get very hot or very cold making it unpleasant to interact with	Could recycled plastic hardware be made that doesn't use bending clips for added durability?	Aluminum hardware is expensive increasing cost of tent
Zippers	Allow easy access to tent interior	Easy to break hard to repair	Explore other closure methods	Ykk is the only consumer recognizable brand. Using other brands will drive customers away but make tent company more vulnerable to supply line problems
Stuff Sack	Fair share system breaks up load into two durable drybags designed to be mounted on bikes.	Forces the user to store their tent in a specific way	Can wet tent parts be separated from dry tent parts?	Increases cost of tent



Dragonfly™ Bikepack Tent 2P  
\$480

Feature or part	Strengths	Weaknesses	Opportunities	Threats
Rain Fly	Subdued color for stealth camping, PU and Silicone coated ripstop nylon for better water resistance, Structured vents reduce condensation	Harder to see at night must be used in conjunction with the rest of the tent	Could increase the the stealthiness by moving to camouflage	Other tents have a rain fly that can be used independently.
Poles	Fairly light and flexible, creates a wind resistant free standing structure, Color coded for ease of setup, shortened segments reduce overall packed size for attaching to bike, DAC is a trusted pole manufacture and has brand appeal	Segmented poles take time to put together	Reduce set up time by using less poles.	Lightning? Carbon or fiberglass single pole tents
Canopy/Inner Walls	Can be used without fly for a secure-feeling bug free shelter, Allows water vapor from breath to pass through keeping condensation away from user	No-sew-um mesh is more fragile than rip stop	Could be made stronger or eliminated to increase durability.	Single wall tents are effective for shelter and don't use inner walls or a canopy
Floor/lower inner walls	Ripstop nylon is fairly durable, fairly light and moderately priced, keeps drafts, pooling water and small animals out	"Bathub" style floors keep water in as well as they keep water out, doesn't drain well	Could be eliminated to increase drainage	Composites like dyneema offer better durability and are lighter
Hardware	Pom clips and other hardware are cheap and light	Easy to break hard to repair	Could use recycled materials	Other tents use aluminum hardware which is much more reliable
Zippers	Allow easy access to tent interior	Easy to break hard to repair	Explore other closure methods	Ykk is the only consumer recognizable brand. Using other brands will drive customers away but make tent company more vulnerable to supply line problems
Stuff Sack	Designed to be mounted to bike handlebars in a durable easy to use package	Only place they can be easily mounted to handlebars, wet and dry parts of the tent must be placed in the same bag making everything wet	Separate possibly wet and dry parts into different bags. Drying on-the-go	Other tents separate tent into more flexible packaging systems



ULTRAMID 2  
\$825

Feature or part	Strength	Weaknesses	Opportunities	Threats
Rain Fly	Ultra-light weight high strength Dyneema, Simple pyramid design can be setup with or without a pole	Less abrasion resistant than some other materials	Use less expensive materials	Inexpensive expensive
Poles	There's only one pole making it fast to set up	Poles is in the center of the tent and is awkward to move around. Not freestanding and depends on the use of stakes	Eliminate pole from the center of the tent	Might be off putting to consumers want the dependability of a freestanding tent
Canopy/Walls	It's single wall so there are none, lighter, less to fail	User needs to more closely manage condensation, less protection from mosquitoes and animals	Is it possible to have a secure, bug free environment without a full canopy and walls?	Consumers may want the security of full walls
Floor	There is no floor, it's lighter and it drains better	Less protection for inflatable mattresses, less security, more drafts	Could we have similar levels of security and draft protection to floored tents without having a floor?	Consumers may want the protection a floor offers
Hardware	Uses lightweight POM plastic	Easy to break hard to repair	Would aluminum hardware last longer and be more sustainable?	Other tents use aluminum hardware which is much more reliable
Zippers	Allow easy access to tent interior	Easy to break hard to repair, Coil zippers are less durable than toothed zippers and only offer advantages when the zipper is required to curve. The zipper on this tent doesn't curve.	Explore other closure methods, toothed zippers	Ykk is the only consumer recognizable brand. Using other brands will drive customers away but make tent company more vulnerable to supply line problems
Stuff Sack	Stuff sack is not included. The user can pick anything they want to put it in	The user needs to provide their own stuff sack.	Could an ultralight stuff sack be included?	Customers might select a tent that has a stuff sack with features for bikepacking

## Benchmark Products

Many existing products have been analyzed above with considerations for their materials, manufacturing methods, features, as well as their strengths and weaknesses. Of these, the author has picked products that most exemplify adaptability, particularly for use on the OTT route. These included the Telos 2p Bikepacking tent from Sea to Summit priced at \$649, the Big Dumpling Hip Pack from Rockgier priced at \$175, the Mission shorts from ORNOT priced at \$118, the Glidepath Pant from 7Mesh priced at \$170, the Sun Hoodie from Ibex and the Helium Rain Jacket for Outdoor Research. Two bottoms and two tops have been selected. Currently, having multiple pieces of apparel is the best way for a bikepacker on the OTT to be prepared for the situations that they are likely to encounter. Apparel samples will be sourced in size medium.

## Testing Plans

The “jobs to be done” analysis included earlier in this paper concludes that apparel and equipment designed for riders on the OTT should primarily intend to increase their adaptability while not increasing the weight of the items that they are carrying. New equipment and apparel designed to meet this need should be compared to existing products. Considering this, tests should be performed in a way that offers a reasonable comparison of the performance of both existing benchmark products and the new products being designed and prototyped by the author.

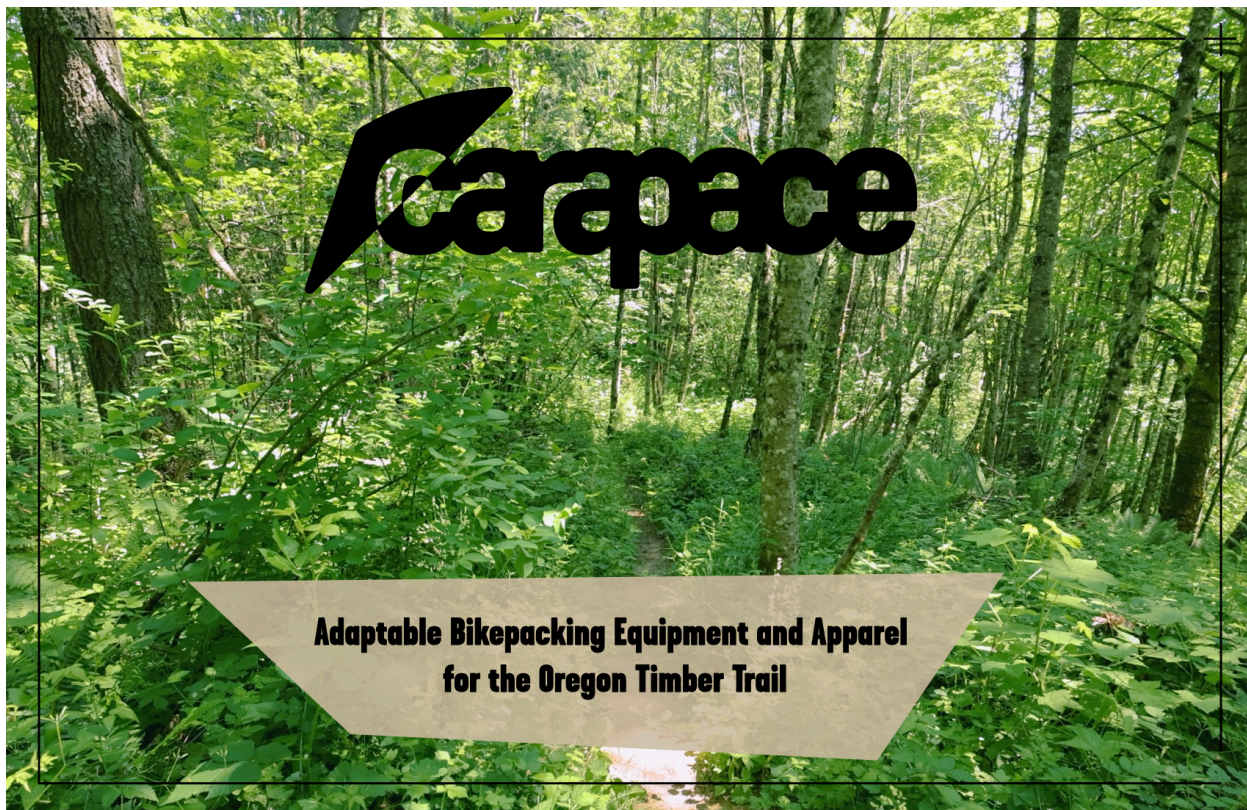
Benchmarking the weight of products can easily be accomplished in a single step and only requires each item to be weighed on a scale. In addition to weight, time is an important measure of adaptability. The more quickly the athlete can adapt a given product to an arising need, the more quickly the athlete can return to engaging in the bikepacking experience. A preliminary testing plan designed to measure these to metrics of adaptability is included below:

Phase	Procedure	Data Collected	Time
Weigh all products	Place each item on a scale and record the weight	The weight of each product in oz.	1 min per item
Find participants for adaptability time tests	Use existing contacts of interview athletes, instagram and bikeshops to find experienced bikepackers		1 week
Obtain consent for human testing from participants.	Have participants sign consent forms.		5 min per participant
Testing bottoms adaptation time from pants to shorts.	Time the athletes speed changing from pants to shorts with a stopwatch.	The time is seconds required to adapt	5 min
Testing bottoms adaptation time from shorts to pants.	Time the athletes speed changing from shorts to pants with a stopwatch.	The time is seconds required to adapt	5 min

Phase	Procedure	Data Collected	Time
Testing bottoms adaptation time from shell to shirt	Time the athletes speed changing from shorts to pants with a stopwatch.	The time is seconds required to adapt	5 min
Testing bottoms adaptation time from shirt to shell	Time the athletes speed changing from shorts to pants with a stopwatch.	The time is seconds required to adapt	5 min
Testing hip pack adaptation time	Time for carrying load on back to carrying load on front and accessing an item inside. Include entire process including adjust meant of apparel worn under the hip pack.	The time is seconds required to adapt	5 min
Test tent adaptation time for precipitation shelter	Time set up of tent in fly only mode	The time is seconds required to adapt	10 min
Test tent adaptation time for creating a gathering/cooking/eating space	Time changing tent to "hang out mode"	The time is seconds required to adapt	10 min
Test tent adaptation time for creating a sleeping space	Time setting up internal tent walls and floor of tent	The time is seconds required to adapt	10 min
Test tent adaptation time for riding	Time repacking the tent	The time is seconds required to adapt	10 min

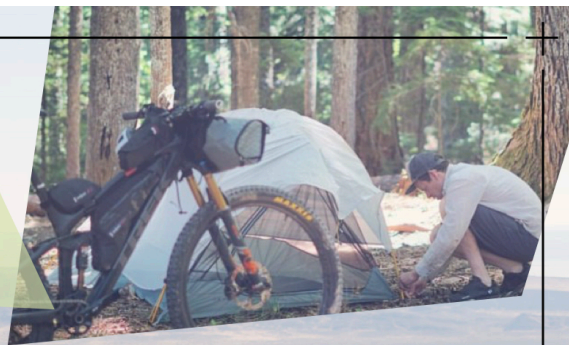
### Prototyping and Innovation

The images below detail the innovation goals, new designs, and prototypes created by the author for each of the product areas mentioned previously. The weaknesses of each selected baseline competitor product are reviewed, compared, and contrasted with design innovation and improvements possessed by the author's works-like prototypes.



## WHAT IS BIKEPACKING?

- Self-supported long-distance mountain bike touring
- Terrain including single-track trail, double-track, gravel roads, and occasionally asphalt
- Extremely challenging conditions



## THE OREGON TIMBER TRAIL

**A Bikepacking Route**  
 Length: 670 Miles  
 Elevation Gain: 66,000'  
 Unpaved: 90%  
 Single Track: 62%  
 Riding Season: June-October  
 Temperature Range: 40°F-90°F  
 Duration: 3-4 Weeks

Crown Mountain  
 Moss Pass  
 Ridgely  
 Warrior Burn  
 Silver Lake  
 Yamnassy Mountain  
 Chemnitz  
 Timpanogus Lake  
 Oakeshige  
 Ryan-Spruce Ridge  
 Wildto Lake  
 Coosville Lakes  
 Stearns  
 Southern Wagon Road  
 Fish Lake, Work Centre  
 Linnatus  
 Brackenwash  
 Ollalie Lake  
 Barlow Trail  
 Sunnyside Ridge  
 Prochata

FREMONT TIER

WILLAMETTE TIER

DESCHUTES TIER

HOOD TIER

### PROBLEM

**ACTIVITIES**  
 Riding  
 Hike-a-bike  
 Off bike exploration  
 Cooking  
 Camping  
 Sleeping  
 Trail side rest  
 Taking photos

**ENVIRONMENTS**  
 High desert  
 Alpine  
 Temperate rain forest  
 Rural towns  
**LOTS OF MOSQUITOES**

How could we design apparel and equipment that support bikepackers' ability to adapt to changing conditions on the Oregon Timber Trail?



**JOB TO BE DONE**  
**ADAPTABILITY**

**SPEED**

The rapidity with which a rider can adapt to new conditions and situations, the faster, farther, and more safely they will travel while having more time for recovery and enjoyment.

**VERSATILITY**

The more needs a single product can fulfill, the less a rider needs to carry, decreasing the physical strain and psychological fatigue.



**JOB TO BE DONE**  
**MOSQUITOES**

- Always referenced in interviews as one of the single greatest nuisances to riders
- Insect bites happen primarily above ground level
- Ticks pose less of a risk compared to eastern routes



**“The mosquitos were crazy. I’ve been to Alaska in the summer and this was worse.”**





**PRODUCT LINE****BOTTOMS****Carpace****CURRENT OPTIONS**

- A pair of both shorts and pants are carried by most riders
- Both are poor at protecting a rider from mosquitos in hot environments
- Fragile and clingy no-see-em mesh
- Carcinogenic DEET

**Carpace**

**RECOMBINANT PANT**



**RECOMBINANT PANT**





**INNOVATION**  
**HARDWARE-LESS WAIST ADJUSTMENT**



**SOFT • COMFORTABLE**

- Improved comfort when wearing a hip pack
- More durable than hard plastic

**Carpace**

**OTHER FEATURES**  
**PAD-COMPATIBLE ARTICULATED KNEES**



**THERMOREGULATING MOSQUITO PROTECTION**

**Carpace**

**TIMED TESTING**



**Carapace**  
Recombinant Pant- \$173

**ORNOT**  
Misson Shorts- \$118  
**7mesh**  
Glidepath Pants - \$170



Adapting from pants to shorts

29.13 second

51.14 seconds

Adapting from shorts to pants

58.64 seconds

45.29 seconds

**A TOTAL OF 10% FASTER**



**WEIGHT TESTING**



**Carapace**  
Recombinant Pant- \$173

**ORNOT**  
Misson Shorts- \$118  
**7mesh**  
Glidepath Pants - \$170



Weight

29.13 second

51.14 seconds

Modes

3 modes

2 modes

**18% LIGHTER**  
**33% MORE PANTS!**



## PRODUCT LINE



**Carpace**

## CURRENT OPTIONS



### PROS

- Mosquito protection
- Spacious headroom

### CONS

- Time-consuming to setup and repack
- Only used for sleeping
- Heavy
- Low floor space



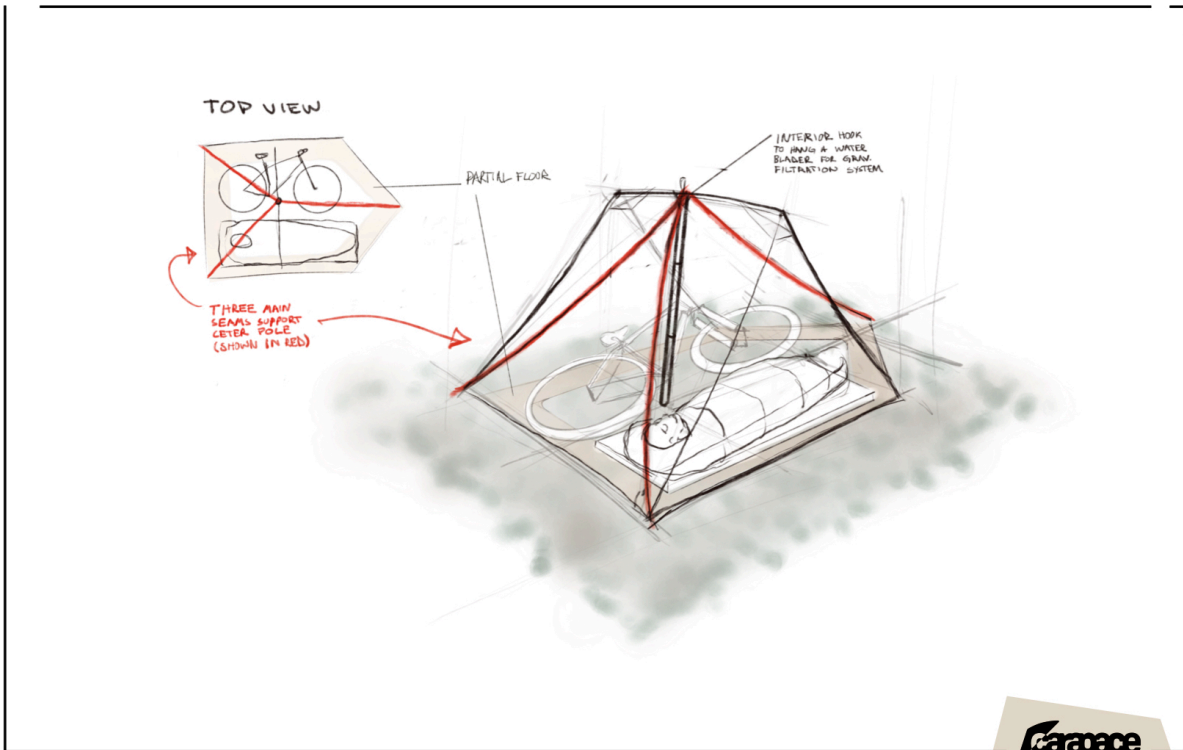
### PROS

- Ultralight
- Gathering during poor weather
  - Meal ride prep
  - Non-athletic recreation
- Fast Pitch and repack

### CONS

- No mosquito protection
- Poor headroom

**Carpace**



**TEA TENT****INNOVATION  
INTERNAL SKIRT****MINIMALIST MOSQUITO CONTROL**

The internal skirt keeps out mosquitoes while retaining the advantages of an open bottom tent.

**FEATURE**  
**FAST PITCH**



**PITCH OVER YOUR STUFF**

An open bottom and t-pole frame allow the tent to be pitched over top of the bike and everything it carries, dramatically reducing the time it takes to shelter.

**Carpace**

**FEATURE**  
**PICTURE WINDOW**



**MOSQUITO-FREE VIEWS**

The just-more-than-single-wall canopy has options for a weatherproof enclosure or great views, with or without mosquito protection

**Carpace**



**FEATURE  
SPLIT PACKING**

**BALANCE + PREFERENCE**

Split packing allows riders to balance weight on the front and back of their bike or chose the most appropriate location of items on their particular rig.

**TIMED  
TESTING**



**Carapace**  
Tea Tent - \$500



**Sea to Summit**  
Tello 2p - \$649

	Unpacking and Dry Setup	
<b>4:58.45 minutes</b>		<b>5:11.97 minutes</b>
	Dry Setup to Hang Out Mode	
<b>44.60 seconds</b>		<b>38.61 seconds</b>
	Hang Out Mode to Sleep Mode	
<b>29.71 seconds</b>		<b>2:48.78 minutes</b>
	Sleep Mode to Repack	
<b>4:40.82 minutes</b>		<b>7:34.21 minutes</b>

**A TOTAL OF 33% FASTER**



**AREA & WEIGHT**



**Carapace**  
Tea Tent - \$500



**Sea to Summit**  
Tellos 2p - \$649

	Weight	
1539 g		2158 g
Cover Area		
63 Sq Ft		47.5 Sq Ft

**29% LIGHTER**  
**25% MORE FLOOR AREA**  
**FAR GREATER INTERNAL VOLUME**



**PRODUCT LINE**



**HIP PACK**



## CURRENT OPTIONS

- Time-consuming to access items
- Requires multiple steps to move the bag around the body
- Moving the pack around your body twists apparel worn under the hip belt
- Sweat created great adhesions between the pack, apparel, and skin, increasing discomfort from twisting

**DON'T GET IT TWISTED**



## VICIS HIP PACK



**Carpace**



**INNOVATION**

**THE CAMTRACK SYSTEM**

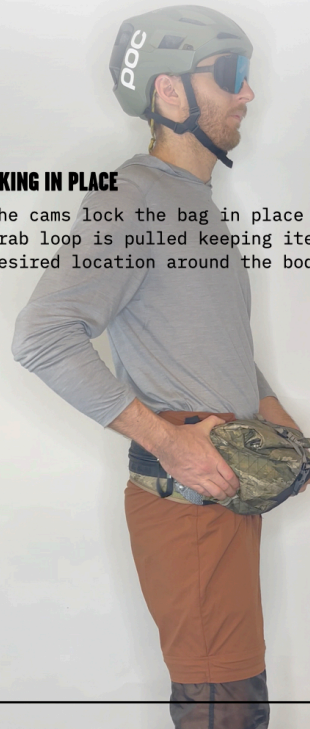
**GENERAL USE**

- The waist belt stays in place to prevent the twisting of apparel and eliminate the need to loosen the belt
- The bag moves independently on a track increasing the speed of access to stored items



**LOCKING IN PLACE**

- The cams lock the bag in place unless a grab loop is pulled keeping items in any desired location around the body



**Carpace**

**INNOVATION**

**THE CAMTRACK SYSTEM**

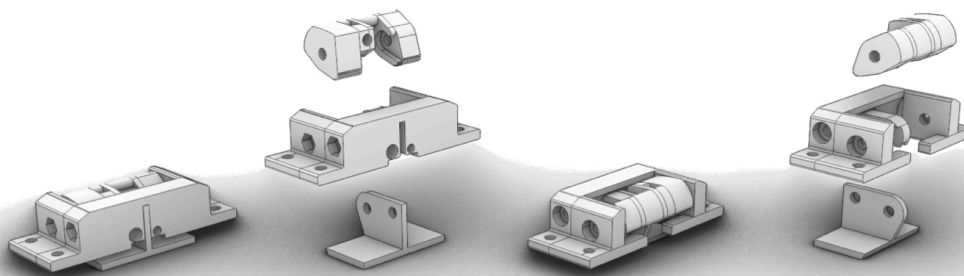
- Inspired by mag-lev trains and cam straps
- Uses two simple cable-actuated cam-locking sliders
- The user pulls grab loops in the direction they want the bag to move
- The cams lock the bag in place when the thumb loops aren't being engaged

**Inspirational Cam Strap**

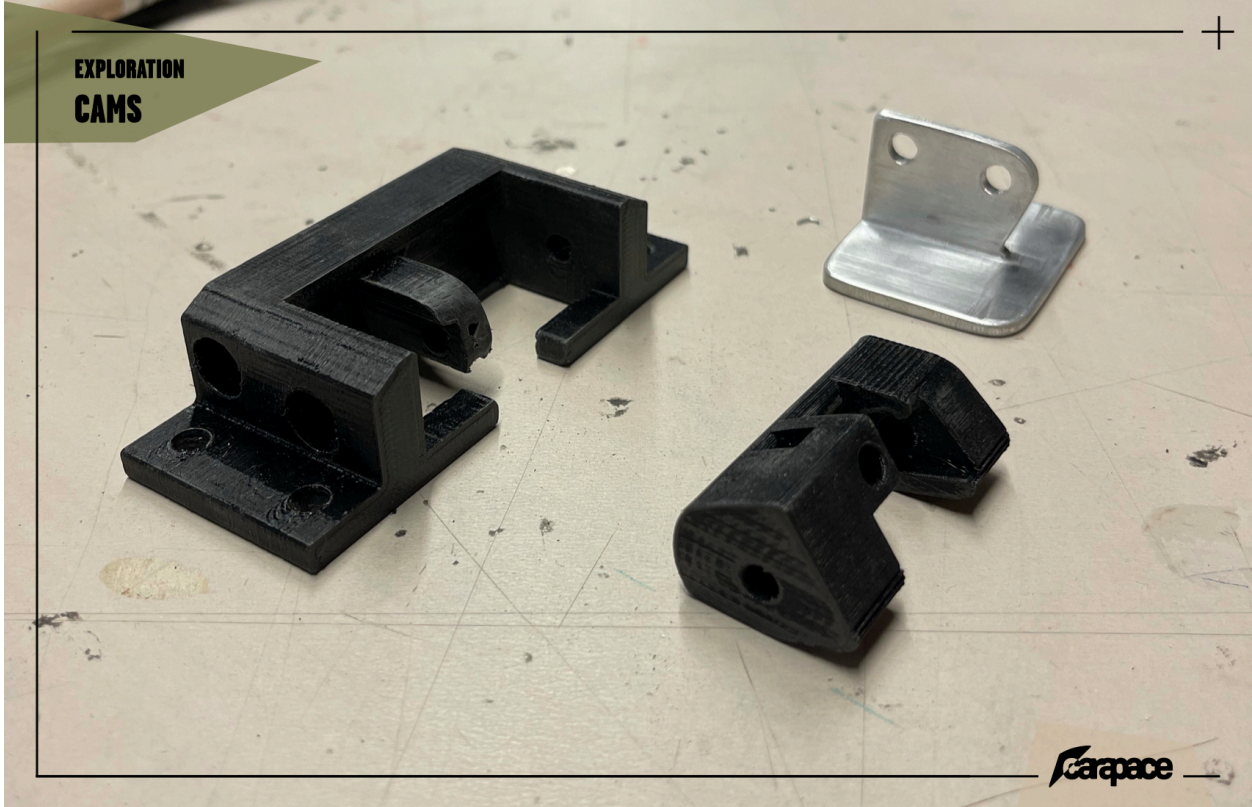
**Inspirational Maglev Train**



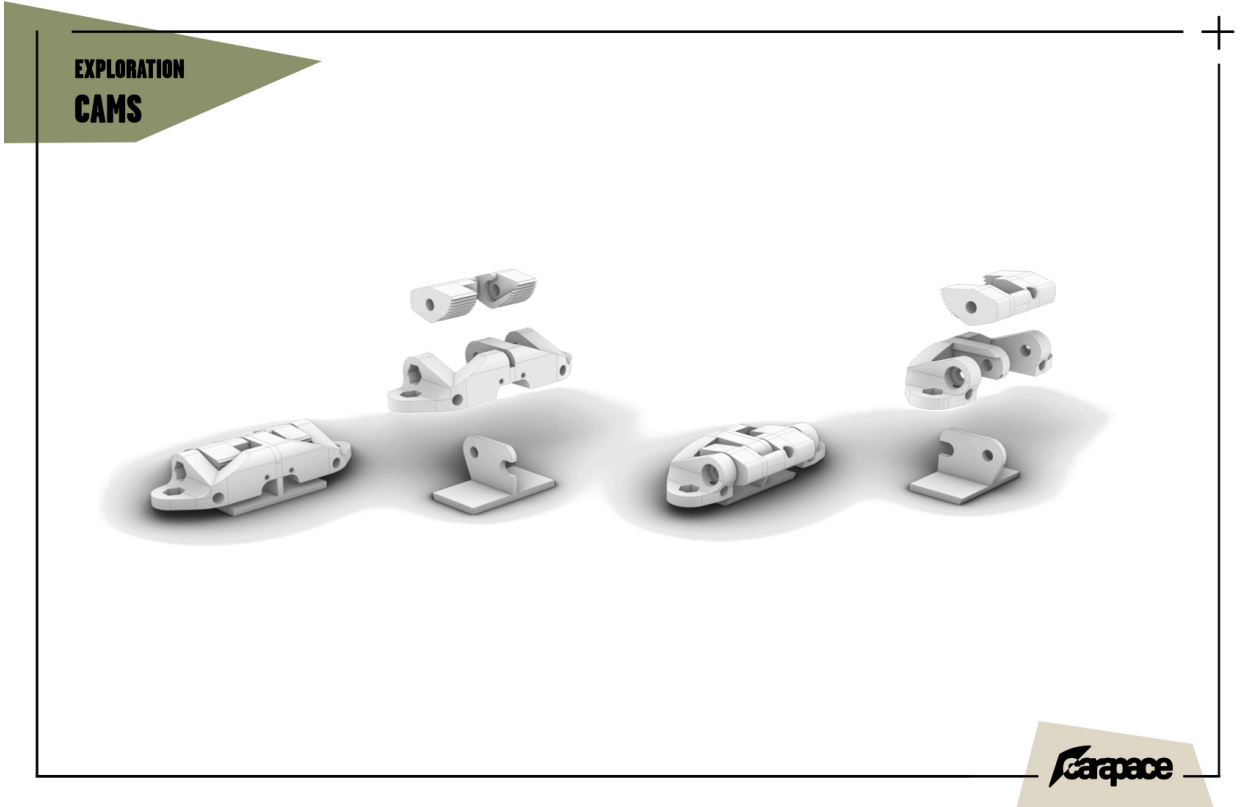
**EXPLORATION  
CAMS**



**EXPLORATION  
CAMS**



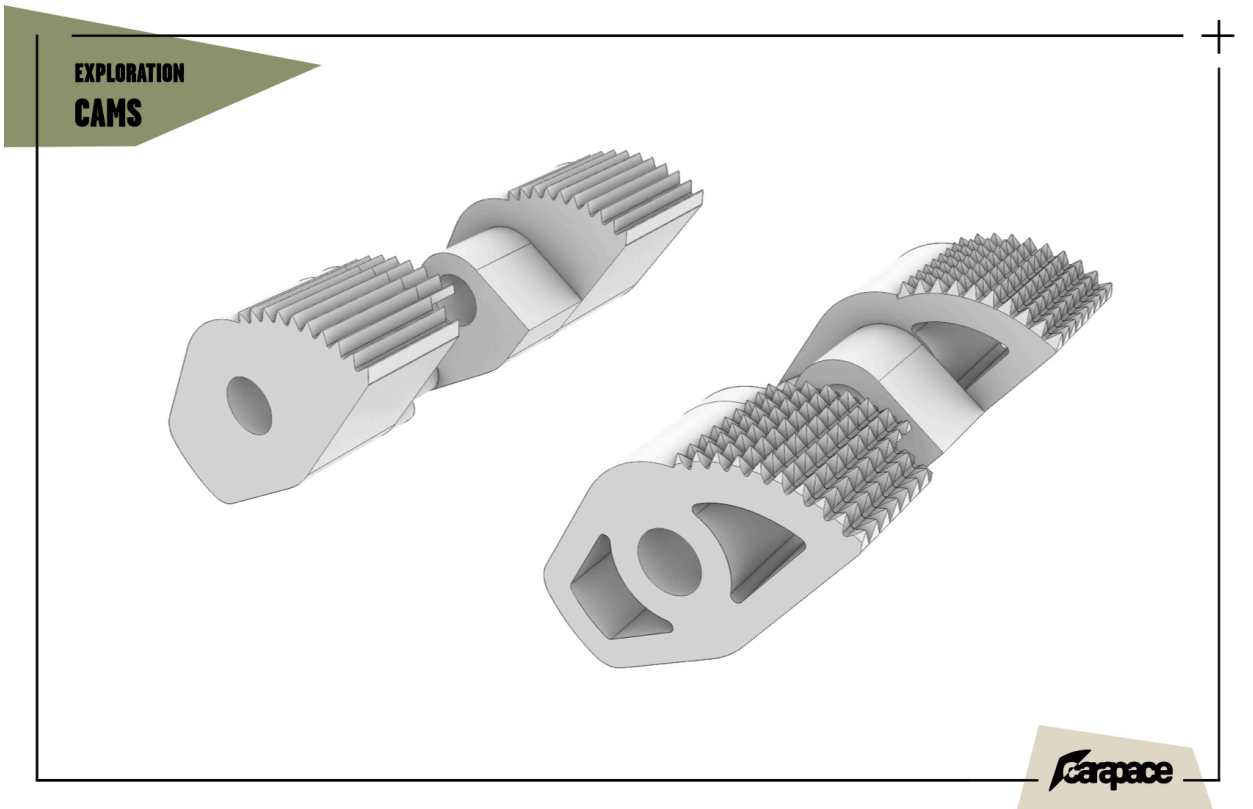
**EXPLORATION  
CAMS**



**EXPLORATION  
CAMS**



**EXPLORATION  
CAMS**



## TIMED TESTING

### WITH CAMTRACK



**Carapace**  
Vicis - \$175

### WITHOUT CAMTRACK



**Rockgeist**  
Big Dumpling - \$175

Avg. Bag to Front Time

**6.37 seconds**

**10.41 seconds**

Avg. Bag to Back Time

**9.31 seconds**

**12.92 seconds**

# A TOTAL OF **33%** FASTER

**Carapace**

## A MORE ADAPTABLE BIKEPACKER

- Faster adaption
- More versatile products
- Heat of the high desert to alpine mosquito swarms
- On trail to in camp
- Riding to photography



**Carapace**

### Testing

Using the testing plans discussed above, the author measured the performance of the selected benchmark products against the prototypes derived from his own designs. The table below compares the weight (and in the case of the tents, the square footage of coverages as well) of the competitor products of the first round of works-like prototypes. In almost all cases the prototypes show favorable improvements to their associated benchmark competitors. The hip pack is an exception to this rule. In this product, initial efforts focused on creating a product that was faster to adapt. The author believes that subsequent prototypes will achieve a similar or lesser weight to the competition.

Product	Weight or Area	Percentage Differences
<b>Bottoms</b>		
Ornot Misson Shorts	262	
7Mesh Glidepath Pants	258	
Total	520	
Carapce Recombinant Pant	431	18% lighter
<b>Tent</b>		
Sea to Summit Telos 2p sq ft	47.5	
Sea to Summit Telos 2p Fly	530	
Sea to Summit Telos 2p internal	505	
Sea to Summit Telos 2p poles	1123	
	2158	
Carapace Tea Tent sq ft	63	25% more floor space
Carapace Tea Tent body	957	
Carapace Tea Tent poles	442	
Tyvek Ground Cover	140	
	1539	29% lighter
<b>Hip Pack</b>		
Rockgeist Big Dumpling	377	
Carapace Vicis Hip Pack	582	35% heavier

After weight, speed was the other meter used to compare the performance of products in terms of adaptability. The following table shows the improvement made by the author's designs and prototypes in this arena as well:

Product	Adaptation Action	Adaptation Time Avg.	Percentage Differences
<b>Bottoms</b>			
Ornot Misson Shorts & 7Mesh Glidepath Pants	pants to shorts	51.14 seconds	
Ornot Misson Shorts & 7Mesh Glidepath Pants	shorts to pants	45.29 seconds	
	total	97.24 seconds	
Carapace Recombinant Pant	pants to shorts	29.13 seconds	44% faster
Carapace Recombinant Pant	shorts to pants	58.64 seconds	33% slower
	total	87.77 seconds	10% faster
<b>Tent</b>			
Sea to Summit Telos 2p	unpack to dry setup	5:11.97 minutes	
Sea to Summit Telos 2p	dry setup to hang-out	38.61 seconds	
Sea to Summit Telos 2p	hang out to sleep	2:48.78 minutes	
Sea to Summit Telos 2p	sleep to repacked	7:34.21 minutes	
	total	16:13.58 minutes	
Carapace Tea Tent	unpack to dry setup	4:58.45 minutes	5% faster
Carapace Tea Tent	dry setup to hang-out	44.60 seconds	14% slower
Carapace Tea Tent	hang out to sleep	29.71 seconds	83% faster
Carapace Tea Tent	sleep to repacked	4:40.82 minutes	39% faster
	total	10:53.64 minutes	33% faster
<b>Hip Pack</b>			
Rockgeist Big Dumpling	bag to front	10.41 seconds	
Rockgeist Big Dumpling	bag to back	12.92 seconds	
	total	23.33 seconds	
Carapace Vicis Hip Pack	bag to front	6.37 seconds	39% faster

Carapace Vicis Hip Pack	bag to back	9.31 seconds	38% faster
	total	15.68 seconds	33% faster

### About the Author

A desire to facilitate enjoyment, transformation, and engagement through sport is at the core of my desire to design for bikepacking. As a maximizer my natural tendency to lean into my strengths. Leveraging my skills in ideation and iterative prototyping allows me to deliver out-of-the-box solutions and, as a positive person, I always believe a better solution exists to any problem and that I'm capable of finding it. My appreciation for the diversity of the human experience also drives my desire to create better products. Rather than using surveys as a means of uncovering user needs, I prefer to conduct interviews, creating a relationship with each athlete to develop more empathetic design solutions.

The main question that my research and designs aim to address is as follows: How could we design products that holistically provide for the entire bikepacking experience? At the heart of any answer to this question, there is a key theme: adaptability. I've chosen to design for bikepacking because it's a sport, or perhaps more accurately, a transformative experience I love. Underpinning bikepacking's transformative nature is the fact that, even with the best apparel and equipment, it necessitates adaptability. Any bikepacking adventure, and particularly a longer route like the OTT, forces the athlete to solve many problems and provide for multiple and often conflicting needs to get from point a to point b. For me, the way bikepacking challenges my ability to adapt offers as much pleasure as the views, as being in nature and being among friends. It's no surprise that adaptability is also one of my key strengths.

Of course, being as prepared as possible will provide a bikepacker with the greatest ability to adapt. Having the tools to meet varied challenges quickly and with ease allows the athlete to be better prepared, both physically and mentally, to meet future challenges, creating the conditions for greater depth of engagement and transformation. I hope that designing for adaptability will push the athlete to meet these future challenges and not only facilitate transformation but enhance it as well.

I believe that this project will help me find a position in outdoor apparel and equipment design. Over the summer of 2022, I worked as a contract apparel designer with Lululemon's advanced concepts department. I succeeded in that role because it allowed me to do what I do best: ideation and iterative prototyping. Designing for riders on the OTT will continue to demonstrate my ability to create innovative features for particular user needs. It will also show that I have the technical abilities to create prototypes and that my ideas are feasible and producible as well as innovative. Continuing to showcase all these abilities will be essential to finding a role in Advanced Concepts design at Lululemon or other companies.

### Strengths

1. Ideation

2. Adaptability
3. Maximizer
4. Woo
5. Positivity

## Golden Circle

Why? I want to create products that facilitate enjoyment, transformation, and engagement through sports.

How? Leveraging my skills in ideation and iterative prototyping as well as my appreciation for the diversity of the human experience to deliver out-of-the-box and empathetic solutions

What? Apparel and sporting equipment


## Mentor Information

Tim Clark

Previous Head of Product and Design at Kitsbow Cycling Apparel

Mentoring agreement ✕ 📄 📧

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**Jesse Sindler** <j.s.sindler@gmail.com>  
to timclark8911 ▾

Fri, Dec 2, 4:49 PM (3 days ago) ☆ ↶ ⋮

Hey Tim!  
Just send this to having proof of our agreement to have you mentor me once a month for the remainder of my thesis project. You can just respond with any kind of affirmation and that will be good for now!

Thanks again,  
-Jesse

---



**Tim Clark**  
to me ▾


10:32 AM (12 hours ago) ☆ ↶ ⋮

Hi Jesse. All good to go.

Tim Clark  
971-285-5671

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**Jesse Sindler** <j.s.sindler@gmail.com>  
to Tim ▾

10:35 AM (12 hours ago) ☆ ↶ ⋮

Great, thanks!

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## Bibliography

Amadeus, G. (n.d.). *Oregon Timber Trail*. BIKEPACKING.Com. Retrieved October 28, 2022, from <https://bikepacking.com/routes/oregon-timber-trail/>

ANACKER, C. (2018, August 12). *25th Infantry Bicycle Corps (1896-97)* • <https://www.blackpast.org/african-american-history/25th-infantry-bicycle-corp-1896-97/>

B D Weiss. (1985). Nontraumatic injuries in amateur long distance bicyclists. *Am J Sports Med*, 13(3), 187–192. <https://doi.org/10.1177/036354658501300308>

Benedict, T. (2016, May 23). *ElevenPine solve performance vs. Fashion woes with form fitting cycling shorts that zip into baggies*. Bikerumor. <https://bikerumor.com/elevenpine-solve-performance-vs-fashion-woes-form-fitting-cycling-shorts-zip-baggies/>

*Big Dumpling Hip Pack | Waterproof | Rockgeist Bikepack USA*. (n.d.). Rockgeist. Retrieved October 28, 2022, from <https://rockgeist.com/product/big-dumpling-hip-pack/>

BIKEPACKING.com (Director). (2022, November 24). *2022 Bikepacking Gear Picks (Editor's Dozen)*. <https://www.youtube.com/watch?v=PpKZ9QBDLiw>

*Bikepacking.com Traffic Analytics & Market Share*. (n.d.). Similarweb. Retrieved October 13, 2022, from <https://www.similarweb.com/website/bikepacking.com/>

*BIKEPACKING.com—YouTube*. (n.d.). Retrieved October 19, 2022, from <https://www.youtube.com/>

Browning, C. (2022, October 11). *Design Capsule: Men's Active All-Terrain Cycling A/W 23/24*. WGSN. <https://www.wgsn.com/fashion/article/94411>

Capps, J. (2012, October 2). *Cycling in Print: National Geographic, 1973. The Simplicity of Vintage Cycles*. <https://simplicityvintagecycles.com/2012/10/01/cycling-in-print-iv/>

Chang, J. (2019, October 14). *17 Branding Trends for 2022/2023: Latest Predictions to Watch Out For*. Financesonline.Com. <https://financesonline.com/branding-trends/>

Codey. (2020, September 2). *How Many Litres For Bikepacking—Bikepacking Capacity -*. <https://cycletraveloverload.com/how-many-litres-for-bikepacking-bikepacking-capacity/>

Concilio, G. (n.d.). (7) *The history of bicycle touring*. | LinkedIn. Retrieved October 12, 2022, from <https://www.linkedin.com/pulse/history-bicycle-touring-gennaro-de-concilio/>

Coons, R. (2019, December 2). *Gore-Tex maker partners with biobased polymer firm | NuU*. <https://biofuelsdigest.com/nuudigest/2019/12/02/gore-tex-maker-partners-with-biobased-polymer-firm/>

Coventry, P. A., Brown, J. E., Pervin, J., Brabyn, S., Pateman, R., Breedvelt, J., Gilbody, S., Stancliffe, R., McEachan, R., & White, P. L. (2021). Nature-based outdoor activities for mental and physical health: Systematic review and meta-analysis. *SSM - Population Health*, 16, 100934. <https://doi.org/10.1016/j.ssmph.2021.100934>

David J.S. Wadsworth & Patrick Weinrauch. (2019). THE ROLE of a BIKE FIT in CYCLISTS with HIP PAIN. A CLINICAL COMMENTARY. *Int J Sports Phys Ther*, 14(3), 468–486. <https://doi.org/10.26603/ijsp20190468>

Diefenthaler, F., Carpes, F. P., Bini, R. R., Mota, B., & Guimarães, A. C. S. (n.d.). *METHODOLOGICAL PROPOSAL TO EVALUATE SAGITTAL TRUNK AND SPINE ANGLE IN CYCLISTS: PRELIMINARY*. 11.

ELEVENPINE. (n.d.). *Elevenpine // The World's First Dual-Fit Shorts*. ELEVENPINE. Retrieved October 12, 2022, from <https://www.elevenpine.com/>

*Essential Layering for Bikepacking: The Six-pack Method*. (2021, November 3). BIKEPACKING.Com. <https://bikepacking.com/gear/layering-for-bikepacking/>

*General 1*. (n.d.). Challenge Outdoor. Retrieved November 3, 2022, from <https://www.challenge-outdoor.com/ecopak>

*Global Bikepacking Community Survey*. (2019, May 15). BIKEPACKING.Com. <https://bikepacking.com/plog/bikepacking-community-survey/>

*Handmade Hip Packs for Bikepacking*. (n.d.). BIKEPACKING.Com. Retrieved October 19, 2022, from <https://bikepacking.com/index/hip-packs-for-bikepacking/>

*Historical Museum at Fort Missoula*. (n.d.). Retrieved September 30, 2022, from <https://fortmissoulamuseum.org/exhibit/25th-infantry-bicycle-corps/>

Katja Oberhofer, Patrick D Wettenschwiler, Navrag Singh, Stephen J Ferguson, Simon Annaheim, Rene M Rossi, & Silvio Lorenzetti. (2018). The Influence of Backpack Weight and Hip Belt Tension on Movement and Loading in the Pelvis and Lower Limbs during Walking. *Appl Bionics Biomech*. <https://doi.org/10.1155/2018/4671956>

Kirby, D. (2020, July 14). Anxiety Sleeping In A Tent. *The Tenting Life*. <http://thetentinglife.com/anxiety-sleeping-in-a-tent/>

Kostiak, Y. (2022a, June 23). *Active Forecast S/S 24: SenseScapes*. WSGN. <https://www.wgsn.com/fashion/article/93984>

Kostiak, Y. (2022b, October 26). *Active Colour Forecast A/W 24/25*. WSGN. <https://www.wgsn.com/fashion/article/6343db607db940edaa985e7c>

Max Kutsenko (Director). (2021, December 5). *How to create a camouflage pattern in Substance Designer*. <https://www.youtube.com/watch?v=em6j09u90Y4>

*Men's Helios Sun Shirt*. (n.d.). Club Ride Apparel. Retrieved December 12, 2022, from <https://www.clubrideapparel.com/products/helios-sun-shirt>

- Men's Helium Rain Jacket*. (n.d.). Retrieved December 12, 2022, from <https://www.outdoorresearch.com/us/mens-helium-rain-jacket-275386>
- Men's Sun Hoodie*. (n.d.). IBEX. Retrieved December 12, 2022, from <https://ibex.com/products/mens-sun-hoodie>
- MiHyun No & Hyo-Bum Kwak. (2012). Effects of environmental temperature on physiological responses during submaximal and maximal exercises in soccer players. *Integrative Medical Research*, 5(3), 216–222. <https://doi.org/10.1016/j.imr.2016.06.002>
- Miles, K. (n.d.). *Oregon Timber Trail Packing List*. The Art of Type 2 Fun. Retrieved December 10, 2022, from <https://bikeithikeit.com/adventure-notes/2018/7/10/oregon-timber-trail-packing-list>
- Milton, A., & Rodgers, P. (2013). *Research Methods for Product Design*. Laurence King Publishing.
- National Temperature and Precipitation Maps | National Centers for Environmental Information (NCEI)*. (n.d.). Retrieved October 25, 2022, from [https://www.ncei.noaa.gov/access/monitoring/us-maps/1/202110?products\[\]=prcp-total](https://www.ncei.noaa.gov/access/monitoring/us-maps/1/202110?products[]=prcp-total)
- Nemo Equipment. (n.d.). *Dragonfly™ Bikepack Tent*. Retrieved October 20, 2022, from <https://www.nemoequipment.com/products/dragonfly-bikepack>
- NOAA(NCEI), N. C. for E. I. (n.d.). *NOAA Monthly U.S. Climate Gridded Dataset (NClimGrid)*. Retrieved October 25, 2022, from <https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C00332>
- Nobuhiko Eda, Kazuhiro Shimizu, Satomi Suzuki, Eunjae Lee, & Takao Akama. (2013). Effects of High-Intensity Endurance Exercise on Epidermal Barriers against Microbial Invasion. *J Sports Sci Med*, 12(1), 44–45.
- Oregon Timber Trail Rigs and Packing Lists*. (2018, August 14). BIKEPACKING.Com. <https://bikepacking.com/bikes/rider-and-rig/oregon-timber-trail-rigs-packlist/>
- OTT Water Source Chart*. (n.d.). Google Docs. Retrieved October 25, 2022, from [https://docs.google.com/spreadsheets/d/1wQL\\_fIEs\\_ScYDE1S-1NO2rlxy5yf7A47wphCC35y\\_Pc/edit?usp=sharing&usp=embed\\_facebook](https://docs.google.com/spreadsheets/d/1wQL_fIEs_ScYDE1S-1NO2rlxy5yf7A47wphCC35y_Pc/edit?usp=sharing&usp=embed_facebook)
- P, L. (2017, November 24). Klattermusen Eir T-Shirt Review. *Best Hiking*. <https://besthiking.net/klattermusen-eir-shirt-review/>
- Pidd, H. (2019, June 13). Break the cycle: Britain's oldest off-road club. *The Guardian*. <https://www.theguardian.com/lifeandstyle/2019/jun/13/break-the-cycle-britains-oldest-off-road-club>

PRISM Climate Group, O. S. U. (n.d.). *PRISM Climate Group at Oregon State University*. Retrieved October 25, 2022, from <https://prism.oregonstate.edu/6month/>

*Rapha MTB Trail Hip Pack | Rapha*. (n.d.). Retrieved October 29, 2022, from [https://www.rapha.cc/us/en\\_US/shop/trail-hip-pack/product/HPX01XXSSA](https://www.rapha.cc/us/en_US/shop/trail-hip-pack/product/HPX01XXSSA)

*Revelate Designs: Bikepacking From The Beginning | Revelate Designs LLC*. (n.d.). Retrieved September 30, 2022, from <https://www.revelatedesigns.com/site/bikepacking-from-the-beginning/>

Rohini Soni, Archana J Lokhande, & Paschal D'souza. (2019). Atypical Presentation of Sweat Dermatitis with Review of Literature. *Indian Dermatol Online Journal*, 10(6), 698–703. [https://doi.org/10.4103/idoj.IDOJ\\_5\\_19](https://doi.org/10.4103/idoj.IDOJ_5_19)

Saha, S. (2018, October 23). Sew-free Seaming Technology in Garment Manufacturing. *Online Clothing Study*. <https://www.onlineclothingstudy.com/2018/10/sew-free-seaming-technology-in-garment.html>

Store, O. O. (n.d.). *Mission Short—Slate*. Ornot Online Store. Retrieved October 28, 2022, from <https://www.ornotbike.com/products/mission-short-slate>

*Thru-riding (5-30 days)*. (n.d.). Oregon Timber Trail. Retrieved October 25, 2022, from <https://oregontimbertrail.org/long-distance-bikepacking>

*Ultralight Rain Jackets for Bikepacking and Bike Touring*. (2016, April 11). BIKEPACKING.Com. <https://bikepacking.com/gear/ultralight-rain-jackets/>

Vitale, K. C., Owens, R., Hopkins, S. R., & Malhotra, A. (2019). Sleep Hygiene for Optimizing Recovery in Athletes: Review and Recommendations. *International Journal of Sports Medicine*, 40(8), 535–543. <https://doi.org/10.1055/a-0905-3103>

Watts, L. (2022a, February 22). *All Terrain Bicycling: An ATB Manifesto*. BIKEPACKING.Com. <https://bikepacking.com/plog/atb-manifesto/>

Watts, L. (2022b, March 22). *Leave No Trace for Bikepackers: Ride. Camp. Respect*. BIKEPACKING.Com. <https://bikepacking.com/plog/seven-principles-for-bikepackers/>

Wattson, J. & 2021. (n.d.). *Not All Shorts Need To Cover Your Knees: The Ornot Mission Shorts Are Amazing!* The Radavist. Retrieved October 28, 2022, from <https://theradavist.com/not-all-shorts-need-to-cover-your-knees-the-ornot-mission-shorts-are-amazing/>

*Website Performance*. (n.d.). Retrieved October 13, 2022, from [https://pro.similarweb.com/?action=upgrade#/digitalsuite/websiteanalysis/overview/website-performance\\*/999/3m?webSource=Total&key=bikepacking.com](https://pro.similarweb.com/?action=upgrade#/digitalsuite/websiteanalysis/overview/website-performance*/999/3m?webSource=Total&key=bikepacking.com)

*Wikiwand—Climate of Oregon*. (n.d.). Wikiwand. Retrieved October 25, 2022, from [https://wikiwand.com/en/Climate\\_of\\_Oregon](https://wikiwand.com/en/Climate_of_Oregon)

Wingo, J. (2014). Exercise intensity prescription during heat stress: A brief review.

*Scand J Med Sci Sports*, 2015: 25, 90–95. <https://doi.org/10.1111/sms.12381>

Zagor, N. (2022, September 30). *New York Fashion Week: Men's Need-to-Know S/S 23*. WSGN. <https://www.wgsn.com/fashion/article/632c806e1d3335c5e39fa71f>