

Specialized Bowhunting Gear for the Pacific Northwest:

Unlock PNW big game bowhunters' potential for endurance and stealth by synchronizing clothing and gear to level the playing field.

Yuxin Mao

University of Oregon, Master of Science, Sports Product Design Program

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Bowhunting History

Archery hunting is a sport with roots dating back to the Stone Age, around 20,000 BC. It has evolved differently across various tribes worldwide, serving purposes such as hunting and warfare (Allred et al., 2019). Despite fading with the advent of firearms, the early 20th century saw a revival sparked by the discovery of Ishi, a native maintaining ancient hunting methods. This piqued the interest of Saxton Pope and Arthur Young, ultimately inspiring modern-day bowhunting in the United States, notably championed by Fred Bear (Allred et al., 2019).

Inspired by Arthur Young's film and a meeting with him, Fred Bear delved into archery, crafting his bows and embracing bowhunting. In 1939, he established Bear Archery, becoming a pioneer in both the industry and the sport. He publicized the sport through successful hunts, ensuring that bowhunting gained wider recognition. As a result, the first official archery-specific deer season in America started in the State of Wisconsin in 1934.



Duxbak Original, 1922



Duxbak Originals, 1972

Figure 1 Duxbak Hunting Clothes

As the sport has grown and become a dedicated season in every state, bow-hunting clothing and gear have not evolved proportionately. Instead, even today bowhunters wear gear

and clothing that have been specifically designed for rifle hunters. One of the earliest dedicated hunting apparel companies was Duxbak. Their hunting-specific features were initially driven by rifle hunters, as seen in Figure 1. Through decades of evolution, the hunting-specific gear itself has experienced steady growth (Dinerman, 2015). For bowhunters, it wasn't until the late 1990s that any specialized apparel was made to suit their specific needs. As camouflage became a critical element and mountaineering apparel brands gained popularity, hunting gear companies started technologies to cater to hunters with special needs (Evolution of hunting gear 2023).

User Focus: Big Game Bowhunters

The athletes focus on in this project will be region-specific and method-specific. The big game bowhunters in the Pacific Northwest region include hunters from the Oregon coastal range to southern British Columbia. The estimated number of bowhunters in the Oregon coast range is 9,309 as of the 2022 season (ODFW, 2021). In 2022, the overall estimated number of big game bowhunters who hunted elk was 18,000 (WDFW, 2022), combining total Oregon and Washington coastal hunters. As the pursuit and ethical harvesting of food become increasingly popular among the younger generation, it is expected that this number will increase in the following years.

Looking at the age range of big game hunters who participate in the sport each year, it generally spans from 16 to the 70s. However, the main consideration is their physical capabilities. Due to challenging mountainous terrains, demanding weather, and elusive big game such as coastal elk and Columbian black-tails, hunters need to be able to carry and hike under load. They also need to be able to draw a 40-pound legal limit bow and preferably a recommended 50-pound bow for effective, ethical kills (DeCroo et al., 2021).

Although physical capabilities are a more critical factor than age in the sport of bowhunting, experience and hunting expertise are often key to a successful harvest. In the event of hunting, big game bowhunters often conduct pre-season scouting, starting from mid-July to late August, before the September general season archery season begins. As the season kicks off, some of the actions these bowhunters undertake include hiking roughly 2 to 12 miles per day in search of the desired game. For example, in elk hunting, they will be calling for the bulls in for the opportunity of shots. Depending on the hunter's choice, some will be waiting, and some will be stalking to set up their shot opportunities. All these actions require expertise and refined skill sets.

Overall, big game bowhunters are sportsmen who practice seasonally in conservation, harvest, and the thrill of archery hunting pursuit and precision.

Performance Problems in PNW Bowhunting

The problems focused on in bowhunting arise from various angles; the design must meet the needs of both the game and the hunter. In the game of hunting in the PNW coast ranges, one of the biggest challenges is the weather limitations. In the window between early September to October, weather in the PNW coast mountains can change drastically throughout the day (US Department of Commerce). Bowhunters hunting in these conditions will be hiking from 2 to 10-plus miles, looking for the right animal for harvest. Within the range of hiking, there will be rain as well as sweat, contributing to moisture management problems. Both outside precipitation and internal moisture will limit the distance and comfort levels a hunter can endure. This limitation can significantly affect their decision-making in the mountains as well as the distance to be traveled.



Figure 2 By hand (Peterson, 2020)



Figure 3 Stabilizer carrying on shoulder (Peterson, 2020)

Although bowhunting has been around since ancient times, as the technology in compound bow improves, there isn't a clear solution of how to carry a bow efficiently while having it accessible in an active hunt. For example, in Figure 2 and Figure 3, hunters are carrying their bow either by hand or using stabilizing as a momentum arm to support the bow on the shoulder.

The challenge in the two scenarios is that during hour-long hikes, the methods will limit the use of hands for navigation as well as quick access for unexpected encounters. In most cases, long-term carrying will also increase fatigue, which then affects hunters' capability of taking an ethical shot.

As the hunter closes in on the game, the focus of the problem shifts to the game itself. Common big game animals such as black bear, elk, and deer prioritize their senses, particularly scent and sounds (Kuiu, 2023). In a situation where the hunter is positioned downwind with good scent control, the sound of drawing a bow, as well as being seen, can be the most critical aspect of the week-long hunt. Not being detected, especially within bow range (10 yards – 50 yards), will place demanding requirements on both the gear and the hunter's abilities.

Environments and Regulations

The Pacific Northwest offers a rich and challenging environment for big-game bowhunting. From the lush temperate rainforests with their dense vegetation and mossy undergrowth to the riparian zones along the numerous rivers, big game hunters are presented with diverse opportunities. The mountainous terrain inland and timber cuts offer a great living space for Roosevelt elks, open fields and logging areas are also a big portion of the coastal hunting range, housing species like black bears, elk, and deer (Oregon Conservation, 2023).

In the current hunting regulations setting, provided the hunter adheres to all stipulations regarding timing and the correct acquisition of tags, there are no specific regulations concerning apparel and hunting packs. However, bow hunters must adhere to a minimum draw weight of 40 lbs for their archery equipment. The limitations on early archery season tags for hunters fall within the September and October range, where adherence to specific units, species, and dates is crucial. Each area has its specific regulations that hunters should be aware of.

Consider the weather's significant role in hunting, as conditions vary throughout the day in the Pacific Northwest in September. Mornings often present cool and misty conditions with temperatures ranging from 40°F to 50°F, as coastal fog and marine layers can shroud the landscape (Oregon Conservation). As the day progresses, the fog tends to dissipate, and temperatures rise into the 60s Fahrenheit range. Considering ungulates are most active during the early mornings and late afternoons (WDFW), hunters can take advantage of the daytime weather to cover long distances and scan for potential game. However, hunters should also be prepared for rain, as the coastal region is known for its unexpected and sometimes heavy showers. Towards late afternoons, there is generally a drop in temperature and an increase in humidity, making it a good time for ambush-style hunting.

September in the Pacific Northwest can be a challenging yet rewarding experience. With the changing weather patterns adding an extra layer of complexity to the hunt, it requires gear specifically tailored to these big game hunters.



Figure 4 PNW environment extracts (Nichols, 2020)

Products Classifications

The product category in this project will emphasize the outer layer apparel system, and how it can synchronize with the hunting pack which allows access to the bow as well as proper moisture management. As a result, the goal is to create a hybrid hunting shell jacket, an extended-day hunting pack that can work with the jacket to help the user ventilate and be able to carry the bow efficiently, as well as a pair of hybrid shell hunting pants. Over designing an outfit with a pack to protect and serve the PNW big game bowhunter's needs.

Line Plan:

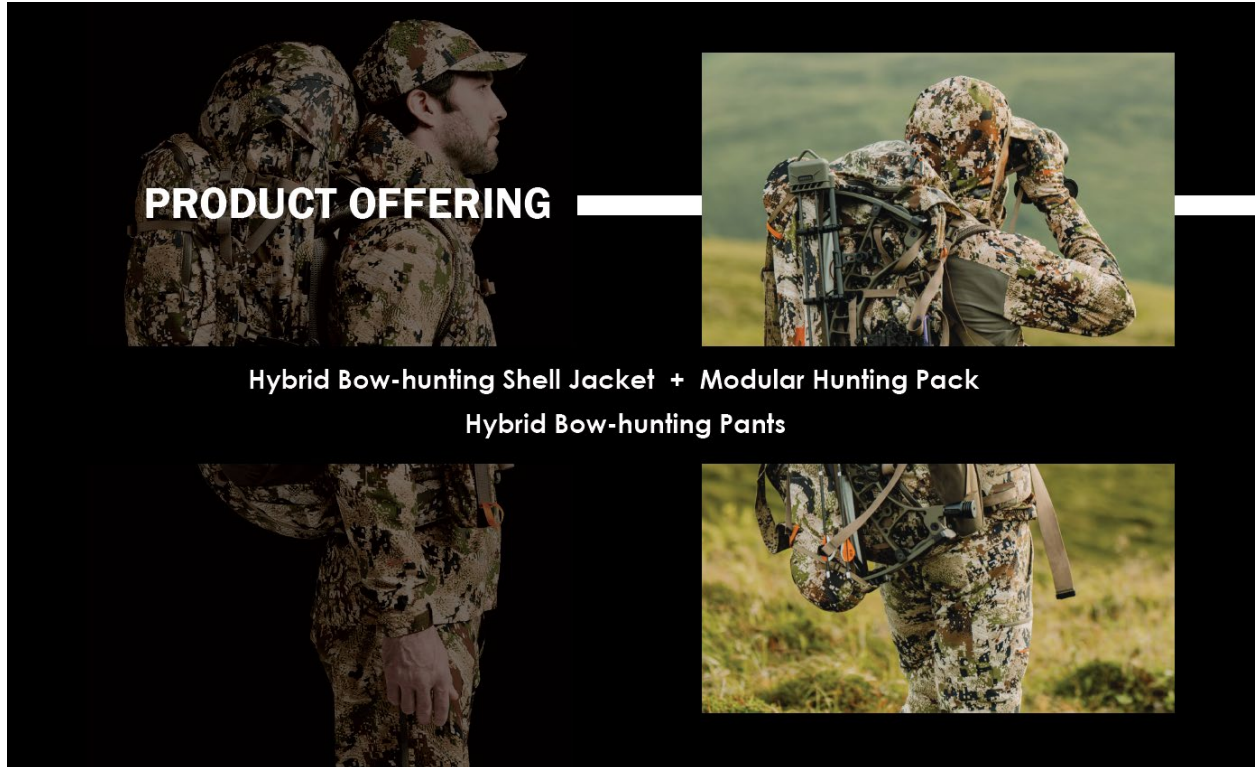


Figure 5 Line Plan / Product

<p>Research 09/2023- 12/2023</p> <p>Athlete Product landscape Product anatomy Job to be done Color/graphics/ branding Survey & results</p>	<p>Field test & research 12/2023- 01/2024</p> <p>Test comp product Document athlete challenges Collect sound data & feedback Understand environment</p>	<p>Meetings 12/2023- 01/2024</p> <p>Meeting with mentors Materials choices/ sourcing Pattern & potential solutions Learn prototyping process</p>	<p>Prototyping 1 01/2024- 02/2024</p> <p>Jacket Pants Hunting Pack System: Sketching Clo3D Patterning Material experiments</p>	<p>Prototyping 2 02/2024- 03/2024</p> <p>Jacket Pants Hunting Pack System: Sewing Assembly Iterations on fit Iterations on color Iterations on features</p>
<p>Prototype test 03/2024- 04/2024</p> <p>Jacket Pants Hunting Pack System: Breath ability Visual effectiveness Bow carrying & access Quietness</p>	<p>Final Prototype 04/2024- 05/2024</p> <p>Jacket Pants Hunting Pack System: Functional and crafted</p>	<p>Final product photography & process doc 04/2024- 06/2024</p> <p>Jacket Pants Hunting Pack System: Photography and videography In environment Presentation slides</p>		

Figure 6 Product timeline

Design Statement

How could we unlock PNW big game bowhunters potential for endurance and stealth by synchronizing clothing and gear to amplify their field encounters and harvest.

Golden Circle Statement

Why: Fueled by a passion for mitigating risks and enhancing human performance in outdoor environments to harmonize the human and natural world

How: By implementing cutting-edge technologies, design processes & materials.

What: Create user-centered designs that seamlessly integrate human experience with the natural world, inspired by the backcountry gear he uses and the diverse aspects of the sports he enjoys.

State of the Art Products

As the bowhunting industry grows, hunting companies are beginning to craft apparel and packs tailored specifically for bowhunters. Currently, a few companies, such as KUIU, Sitka Gear, and First Lite, dominate the market in big game bowhunting. These companies have drawn inspiration from the world of mountaineering to revolutionize hunting gear in terms of fabrics, patterning, and construction. While there is no current landscape of big game bowhunting products specifically designed for the Pacific Northwest, some gear's climates and purposes overlap with PNW conditions. The products listed for comparison will be those most suitable for big game bowhunters in the PNW. The current state-of-the-art rainshell product choices include

Sitka Gear's Dew Point Jacket, Kuiu's Chugach TR Shell, and First Lite's Vapor Storm Lite. These are the lightweight waterproof options offered by the top 3 hunting brands.



Figure 7 Rain Shell Jackets Comparison (left-Sitka, middle-Kuiu, Right-First lite)

Sitka Dew Point jacket comes in at \$349, the 3-layer GORE-TEX Dew Point Jacket offers lightweight waterproof protection for volatile weather. Minimalist construction features include a 20-denier nylon ripstop face with soft GORE® C-KNIT® backer technology for breathable comfort and packability, pit zips for expelling heat, micro-taped seams to reduce weight, and zippered pockets that are accessible while wearing a pack belt and Mountain Optics Harness (Sitka Gear), additionally, the jacket offers a Gore Opti-fade subalpine camouflage that helps the hunter to blend into the PNW environment, although the jacket is lightweight, it doesn't offer back breathability as well as bowhunting specific fitment.

Kuiu's Chugach TR Shell comes in at \$319, this rain jacket features pit-zip ventilation, adjustable cuffs, a 2-way adjustable hood, and multiple zippered pockets. It's designed for comfort and practicality, with raglan sleeves, strategically placed cuff tabs for bowstring clearance, and raised zippered hand pockets that won't interfere with a backpack hip belt (Kuiu), addition to the more intricate pattern design, Kuiu uses a 4-way stretch rains shell main fabric to

provide stretch for the hunter while keeping them dry. However, the jacket only has pit zip ventilation and does not work with the pack itself.

The first lite vapor storm light retail price comes in \$250, this lighter weight jacket is designed with 37.5 Active Particle Technology for moisture management, temperature regulation, and odor control. This lightweight and breathable foul weather system is claimed to be perfect for high-exertion backcountry hunts while offering a comfortable fit, 3D Turret™ hood, shooter-friendly sleeves, and built-in stretch for full mobility (First lite). Although the vapor Stormlight has a lighter shell and claims to have better breathability, it doesn't offer the same pit vent zip that other companies provide.

While the primary focus of this project is to address breathability, moisture management, concealment, and ease of use for bowhunters, it's crucial to recognize the significance of pants in ensuring that hunters stay dry and efficiently manage moisture while also providing adequate protection during their pursuits. The selected pants will complement the chosen jackets. Each company offers a rain shell system comprising both tops and bottoms to maximize the gear's effectiveness



Figure 8 Rain Shell Pants Comparison (left-Sitka, middle-Kuiu, Right-First lite)

Sitka's dew point pants come in at \$329, it is minimally featured including seams and zero pockets, and are made from a 20-denier nylon ripstop face with GORE® C-KNIT® backer technology for easy movement and packability in the mountains. Additionally, there are two-way side zips that offer easy on/off and venting.

Kuiu's Chugach TR rain pants come in at \$269. According to Kuiu's website, the Chugach TR rain gear utilizes Toray's Torain (TR) waterproof technology, it offers a 400% increase in abrasion resistance while shedding nearly 20% of its combined jacket and pant weight (5.4 oz). Enhanced breathability, rapid drying, and a 20% tear strength boost make it a capable product for mountain hunts (Kuiu). Features also include an adjustable waist, full-length side zippers, articulated knees, gusseted crotch, and Bemis overlay film scuff guards for added durability. The pants don't offer any pocketing but do provide venting while fully unzipped.

First Lite Vapor Stormlight Pants come in at \$225, the pants utilize the same 37.5 Active Particle Technology for moisture management, temperature regulation, and odor control fabric used in the rain jacket, however, the features include watertight zippered pockets, full side zip ventilation, and easy boot fitting (First Lite).

To conclude the apparel state-of-the-art products, rain shell jackets generally have less ventilation in the back panel considering the hunters will mostly wear hunting packs while hiking in rain. Although the jackets provide pit zips, which ideally keep the rain shed away from penetrating through the body, it is considerable to provide efficient venting where the sweat accumulates on the back of the individuals, as well as improve hearing capability through the hood while raining, fitment for bow drawing action and quietness while moving. The rain shell pants generally do not provide pockets and additional protection on the leg, but they do have full-side zip mechanisms to help hunters ventilate. In the current rain system that exists in the

companies, a few things could be addressed by integrating the rain shell and soft-shell pants to provide adequate waterproofing, but also provide customizable ventilation as well as padding protection for any stalking movements.



Figure 9 Hunting Packs (Sitka Mountain 2700, Kuiu Pro 3600, Mystery Ranch Pop-Up 40)

In today's competitive landscape, hunting packs offer numerous options suitable for PNW hunters. A big game bowhunting backpack must carry hunting gear and transporting harvested game meat from the field to camp or the car. These packs are known for their load-carrying capacity, gear protection, organization, and comfort. For this project, three reference competitors have been selected: Sitka Gear, Kuiu, and the specialized pack brand, Mystery Ranch. Analyzing Sitka Gear and Kuiu's packs provides a consistent approach within their product lines and aids in understanding how apparel and packs can complement each other, using these brands as examples.

Consider the Sitka Gear Mountain 2700 pack, priced at \$339. This pack offers streamlined organization and storage tailored for big game hunters. According to Sitka, the Mountain 2700 is a rugged day pack capable of quietly supporting loads of up to 45 pounds (Sitka). It features an internal hydration sleeve accommodating bladders exceeding 3 liters to ensure hydration. Additionally, there's an internal zippered security pocket for storing tags, keys,

or a cell phone, while two vertical exterior pockets are ideal for rain gear, a Flash Shelter, or most spotting scopes. The side pockets are designed to secure tripods, trekking poles, or water bottles, and the triple-density foam waist belt provides maximum comfort. Velcro placements on the waist belt allow for easy attachment of pistol holsters, bear spray, and other accessories. The material used in the pack consists of 220-denier nylon with a PU-coated face and back, along with 450-denier polyester reinforcements on the back pockets and bottom panels. While the pack offers essential and innovative features and placements, it lacks special anchoring points for easy access to the hunter's bow. The back panel provides minimal ventilation and lacks specific features that complement the jackets. Although the pack can shed water, it does not utilize waterproof materials on the top portion, potentially raising waterproofing concerns.

The Kuiu Pro 3600 pack comes in at \$640, this fifth generation Kuiu Pro pack offers organization with internal and external pocketing. It has a built-in load sling mode for additional storage and is hydration compatible. Kuiu packs generally use their pro suspension which provides comfort and durability with features like wide shoulder straps, an adjustable hip belt, lumbar height adjustment, and a center-pull belt adjustment system. Additionally, the Kuiu carbon fiber frame, weighing only 11 ounces, can carry up to 150 pounds and offers customization. The Kuiu pack features high-quality materials, including CORDURA® 500D fabric, YKK® Zippers, Duraflex® Hardware, Hypalon compression straps, and Chomarat® Spread Tow Carbon Fiber. Kuiu differentiates itself from the Sitka Gear pack by using specialized fabrics from high-end manufacturers, enhancing both durability and weight reduction. However, Kuiu's pack lacks frontal bow-carrying capabilities. On the positive side, the Kuiu pack incorporates a body-mapped back panel, providing ideal ventilation and maximum padding. This feature significantly reduces sweat during active hunting hikes.

The last competitor pack in this landscape is the Mystery Ranch Pop-Up 40, this pack comes in the price of \$425. This pack is a higher-volume daypack that has a lower profile option. Mystery Ranch offers the OVERLOAD® feature allows hunters to instantly transform it into a bona fide meat hauler, the telescoping frame offers an 80-lb capacity that houses the bulk of the weight close to the hunter's back for prolonged comfort during long hauls back to the car or camp (Mystery Ranch, 2023). In the scenario of moving on the go, the Pop-Up 40's face compression can stow a bow or rifle, freeing your hands for trekking poles or navigating difficult terrain, like the Kuiu's Pro Pack and Sitka Mountain 2700. In addition to the hunting-specific designs, ample pockets, and storage compartments can stow gear and rations close at hand. The Pop-Up 40 excels beyond certain competitors in the current landscape due to its separating frame features, which enable efficient compartmentalization of gear and meat. However, the Mystery Ranch pack has drawbacks, such as the lack of a breathable back panel and convenient bow access. It is primarily designed for carrying heavier cargo rather than providing swift on-body access.

Concluding the packs design throughout the competitors, the good take way from all the pack designs will be having targeted item-specific storage, this will require user research and an in-depth understanding of bowhunter's habits and their needs in certain areas of the backpack. The comparisons of the packs mainly focused on extended-day packs that can carry game meat in quarters (40-65lb) (Argali). However, within this category, some of the specific problem to be solved for PNW hunters would be having easier access to their bow, providing sufficient waterproofing mechanism for the pack, as well as additional storage of gears in the front of the pack, such as bino placement. Most importantly, finding a way to synchronize the pack with the rain shell to provide maximum comfort and breathability.

Job to be Done

Apparel in PNW Bowhunting: Bowhunters in the Pacific Northwest face a series of distinct challenges when it comes to their choice of apparel. Staying dry is paramount in this region known for its frequent rain. Apparel must not only be waterproof but also equipped to shed water efficiently. This gear should strike a balance between sealing out moisture and allowing for effective ventilation as hunters traverse varying elevations and conditions. Moreover, apparel should be designed with ample storage solutions, ensuring quick access to essential tools and gear without disrupting the stealth required in bowhunting. It should also provide the flexibility and silence necessary for smooth drawing and movement. Additionally, protecting joints from the rugged PNW environment is a consideration, especially for the knees and elbows in actions such as stalking or ambushing the game.

Packs for PNW Bowhunting: When it comes to packs for Pacific Northwest big game bowhunting, several critical functions come into play. First, these packs need to complement the hunter's jacket by providing effective ventilation systems that manage moisture without compromising the dryness of gear. They should also be equipped to carry game meat securely and comfortably, offering sturdy load-bearing capabilities and smart meat storage options. Furthermore, these packs must protect sensitive gear like optics and electronics from the region's notorious rain, ensuring that essential equipment remains dry even in heavy downpours (*Tips & Tricks: Bow Hunting in the Rain*, 2022). In addition to their protective features, packs should allow hunters to carry their bows smoothly, ensuring quick, silent access for any surprise encounters. In many cases, having the bow compressed down on the back of the pack can cause

issues like losing the arrows while going through dense vegetation and unexpected damage that could be prevented by keeping the weapon system visible and accessible.

Overall, the big game bowhunting in the Pacific Northwest demands specialized gear designed to address the unique challenges of the region. The unforgiving weather conditions, dense forests, and mountainous terrains require apparel that excels at keeping hunters dry, ventilated, and mobile while also offering streamlined storage options. Therefore, apparel must be engineered to ensure smooth drawing and movement, a crucial element in bowhunting where stealth is key. Additionally, protective features for joints are desirable, given the challenging and uneven terrain. Packs, on the other hand, must focus on efficient ventilation, secure game meat transport, and safeguarding valuable gear from the constant rain. They should enable hunters to move swiftly, silently, and with easy access to their bows, enhancing the overall hunting experience in the territory of Elk, Deer, and Bear.

Product Parts

Rain Jackets and Pants Materials: Rain jackets and pants are constructed with a focus on keeping the wearer dry and comfortable in wet conditions. The primary materials used in these garments often include synthetic fabrics with specialized coatings. One of the most common materials is nylon, known for its durability and lightweight nature. These fabrics are typically woven tightly to provide water resistance and are often further enhanced with a polyurethane (PU) or similar waterproof coating. These coatings prevent water from penetrating the fabric while allowing moisture vapor to escape, thus providing breathability. Another popular material is polyester, which is known for its strength and resistance to abrasion. Additionally, some high-end options may feature laminates such as Gore-Tex, which consists of multiple layers designed

for waterproofing and breathability. These laminates often include ePTFE (expanded polytetrafluoroethylene) membranes.



Figure 10 Apparel parts and materials

In the current market, the most efficient waterproofing with breathable capabilities is achieved through Gore-Tex 3-layer construction. This construction comprises a shell typically crafted from nylon or polyester, a membrane made from materials such as Teflon or polyurethane, designed to repel water while allowing sweat to escape, and finally, a backer closest to the body, primarily composed of polyurethane. Taking the Sitka Dew Point jacket as an example, Gore-Tex has incorporated a C-KNIT® backer to enhance freedom of movement and overall comfort during wear (Sitka Gear, 2023). In conclusion, these contemporary materials provide highly effective waterproofing, which is why they are consistently employed in the rain shell systems of various hunting gear companies, optimizing the performance of their hunting apparel.

Additionally, seam tapes play a crucial role in making these garments waterproof. They are applied to the inside of the seams to prevent water from seeping through the needle holes created during the sewing process. Rain jackets and pants also feature waterproof zippers, usually made of plastic or coated metal to prevent water penetration.



Figure 11 Hunting Pack Details

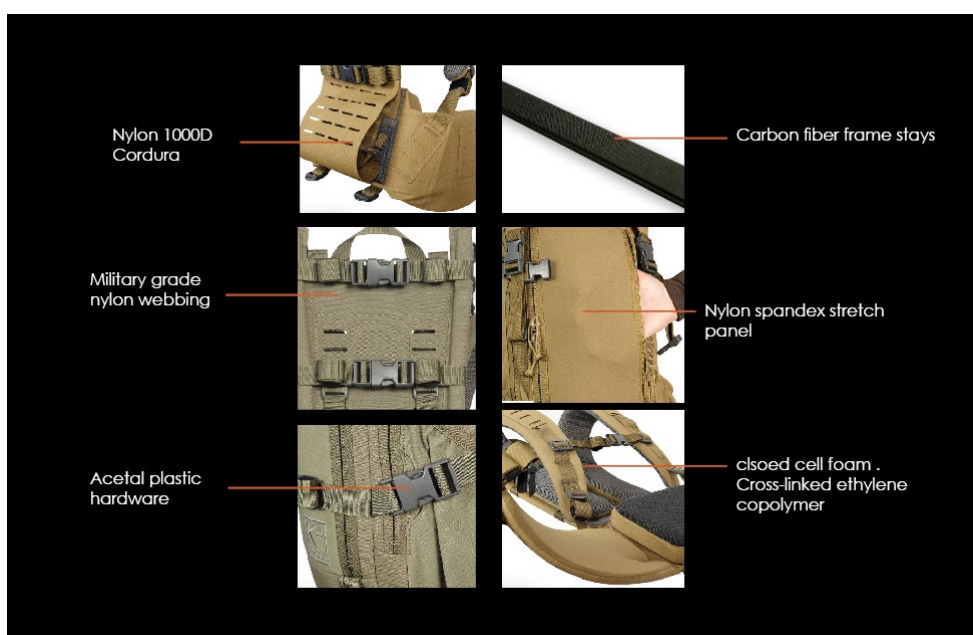


Figure 12 Hunting Pack Construction Materials

Hunting packs are composed of intricate components and rely on robust materials. These packs often feature Cordura fabrics, renowned for their durability. These fabrics are predominantly nylon-based, known for its strength and resilience, ideal for heavy-duty outdoor gear. YKK zippers are commonly employed for their reliability, especially in waterproof applications, using PU-coated coil zippers to prevent water ingress. The hardware in hunting packs, crucial for securing and transforming the pack, is typically crafted from nylon or Acetal. Duraflex, a trusted brand, frequently supplies such hardware, with their high-end materials primarily made from Acetal. Acetal, also known as "polyacetal" or POM, offers exceptional stability, strength, resistance to solvents and abrasion, and reduced wear, friction, and fatigue, making it a preferred choice for hunting gear. Additionally, hunting packs incorporate Spacer mesh in back panels to enhance comfort and breathability, and these are generally made from polyester in high denier counts. The foams used in lumbar pads, hip belts, and shoulder harnesses are constructed from durable closed-cell foams made with cross-linked ethylene copolymer. These foams offer superior softness, structure, and resilience, ensuring consistent performance even in challenging conditions. These high-quality materials are a hallmark of premium hunting gear, guaranteeing that the backpacks are rugged, long-lasting, and up to the demands of backcountry hunts.

Product Manufacturing

The production process of hunting rain jackets and pants involves a series of intricate steps and the use of specialized machinery to ensure both their durability and waterproof capabilities. This manufacturing process typically commences with the careful selection of high-performance materials, often comprising durable nylon or polyester fabrics with waterproof

coatings or laminates, such as Gore-Tex. These fabrics serve as the outer shell of the garments, and they are specifically treated and printed before being cut using precision computerized cutting machines. These machines guarantee the accurate cutting of fabric pieces according to the garment's design.

Following the cutting process, the fabric components advance to the sewing phase, where industrial sewing machines expertly stitch them together, forming the structure of the garments. Advanced sewing techniques are employed to create seams that are not only strong but also waterproof. Simultaneously, the necessary hardware, such as zippers and fasteners, is attached to the garments.

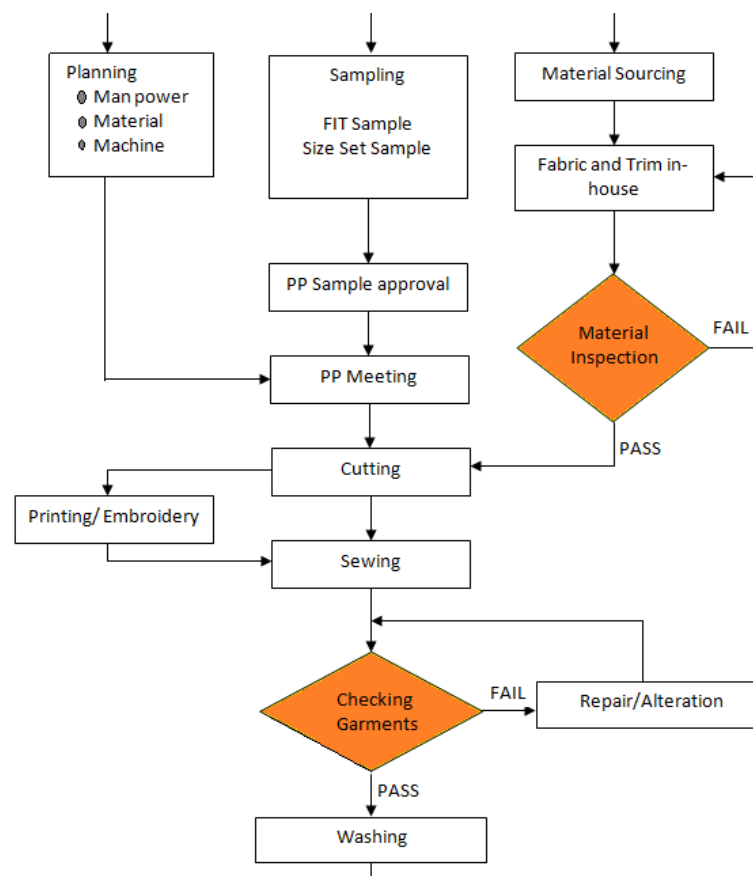


Figure 13 Apparel step assembly (Textile Lesson, 2023)

While the garments are being sewn, hardware components are also affixed to them. After this step, the jackets are assembled and sent to seam taping for waterproofing. Seam tape machines are used for this critical waterproofing process. They apply waterproof tape over the seams of both the jackets and pants, effectively sealing the needle holes created during sewing and preventing water from seeping through these areas. It's important to note that the quantity of tape used can influence the breathability of the garment, with excessive tape potentially reducing its breathability.

In summary, the production of hunting rain jackets and pants requires a combination of specialized machinery, skilled labor, and unwavering attention to quality and precision. The manufacturing of hunting packs is an intricate, multi-step process, commencing with the careful selection and preparation of materials. Whether it's an intricately featured bino harness or a robust meat-hauling backpack, these packs can encompass tens to hundreds of individual components.

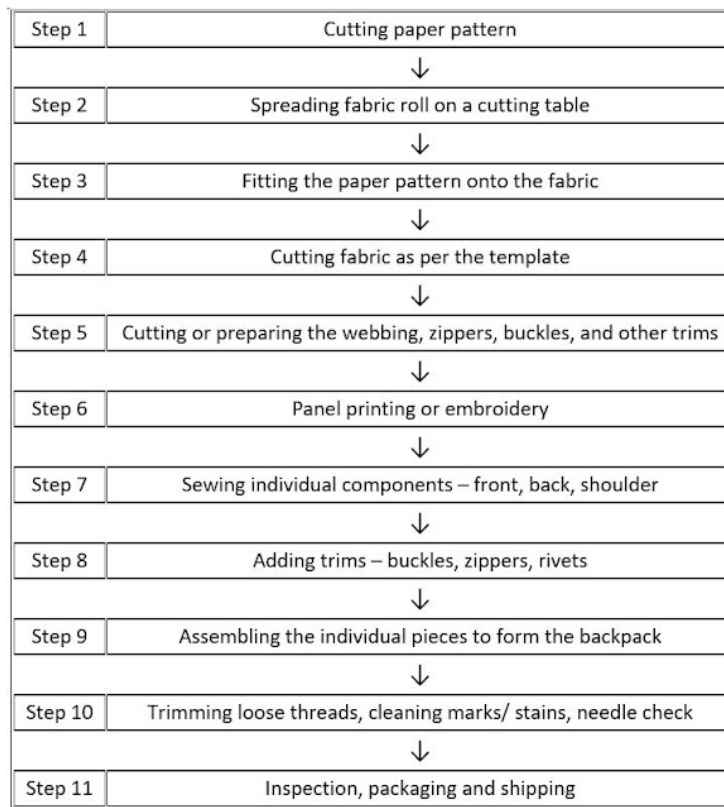


Figure 14 Pack assembly order (Ray, 2022)

The standard procedure for crafting backpacks includes material selection, proofing, sample development, die cutting, hand-picking, vacuum forming, and laser cutting (Ray, 2022). Subsequently, these pieces are intricately stitched together, encompassing multiple facets like assembling the front piece, side panels, back panels, foams, shoulder straps, hip belts, lining, pockets, and various components. Within each of these processes, there may be smaller steps and specific techniques involved, including the utilization of a cylinder-arm sewing machine, heavy-duty walking foot sewing machine, and other specialized machinery for external frames.

A pivotal aspect in the creation of hunting packs is the integration of webbing and straps to securely hold weapons. The inclusion of these elements requires expert finesse to seamlessly blend into the pack's design. The production process of backpacks is a time-intensive endeavor,

with the overall timeline influenced by variables like design complexity and customization requirements. It's a critical contributor to ensuring the final hunting pack is robust, fully functional, and adept at meeting the rigors of the great outdoors.

Intellectual Properties

In the realm of hunting products on the market, numerous patents cover specific mechanisms and features. While some patents have efficiently addressed complex issues in hunting gear, it is equally important to avoid certain mechanisms and reference existing inventions.

Taking a closer look at a current bowhunting jacket that emphasizes ventilation from a patterning perspective. Buck n' Bass, an outdoor sporting goods company specializing in fishing and hunting, offers the Reservoir Rain Shell jacket, which includes a patent (US 2021/0052022 A1) related to rain shell ventilation. This jacket employs overlapping materials in the back panel's patterning to create space and ventilation for the user. The upper pattern from the neck to the mid-back is larger than the pattern below, thus forming a gap that allows the user to breathe comfortably while wearing the rain shell. However, if the user is also wearing a pack, the compression may hinder the mechanism's effectiveness in facilitating ventilation. Therefore, there is room for improvement to enable this ventilation style to work seamlessly with a pack system (George, 2022).

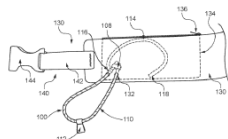
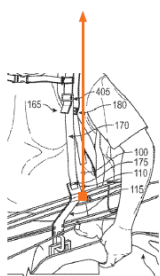
In the field of bow carrying, there are a few examples that allow the bow to rest while the person is hunting. One example is the WL Gore collaboration effort with Sitka Gear, a specialized hunting company that is at the leading edge of the hunting gear industry. This patent (US 11,253,049 B2) looks at a carrying device that can temporarily hold the weapon that a

BOW CARRIERS:**W.L. Gore**

Carrying devices made for weapons and solving for weight balance.

Bowhitch / Padilla

Bow holder for easy access and quiet deployment on field

**BREATHABLE JACKET:****Buck & Bass:**

Vent that moves with the athlete's motion to pump heat

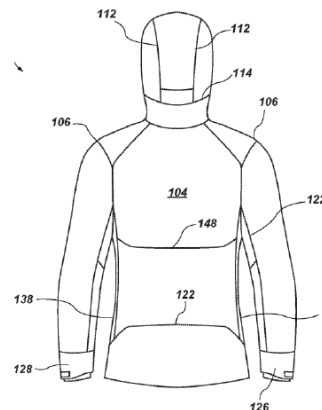


Figure 15 Bow carrying devices. US 11,253,049 B2, Jacket US 2021/0052022 A1

hunter is carrying. This device is currently patented and utilized in their pack lineup, such as the Apex Pack (Barklow, 2018). The mechanism is a retractable cord made from nylon and can create a loop in order to conform to whichever the weapon system is, allowing for resting as shown in Figure 12. The retractable cord can be embodied into the front of the pack, allowing the user to rest their bow or rifle on the loop in case hands-free movements need to be done.

Lastly, hunting packs and systems have extensive patents in place to prevent conflicts among companies in the hunting field regarding their inventions. One notable example is the Mystery Ranch patents (US8579171B2) for their hunting pack framing system in 2013. This specific design focuses on enabling users to pack their meat between the cargo and frame, utilizing webbing and fabric to securely hold the meat for optimal weight distribution and easy offloading while keeping the cargo clean. In Figure 13, it demonstrates how the pack can separate from the frame. The design also reduces body contact with the pack, leading to improved ventilation (Dana, 2013). However, there is potential for improvement by exploring a

different system that still allows for meat packing. In this project, avoiding replicating this mechanism and design is ideal.

Color and Graphics & Branding Trends

The current hunting field is experiencing a surge in new companies and various camouflage patterns that many consumers are vying for. In hunting, the choice of camouflage colors and graphics is crucial for functionality. The concept of camouflage is to conceal the person by breaking up the four corners of the human silhouette and blending them into the environment.

In the case of Pacific Northwest bowhunting, where the terrain mainly consists of coastal mountain ranges with forests, vegetation, and open timber cuts, the period between September and October presents a range of colors, including green, tan, and dark shadow backdrops. Understanding these colors is essential when designing camouflage. The currently most popular brands and camouflage patterns used in this area are Sitka Subalpine, Kuiu Verde, and AOR2 from the US Navy, primarily due to their green palettes. According to the current WGSN trends in the outdoor field for 2024, potential colors that can be used to blend with the PNW environment are black, sea kelp, cream, oat, and sepia (WGSN, 2023).

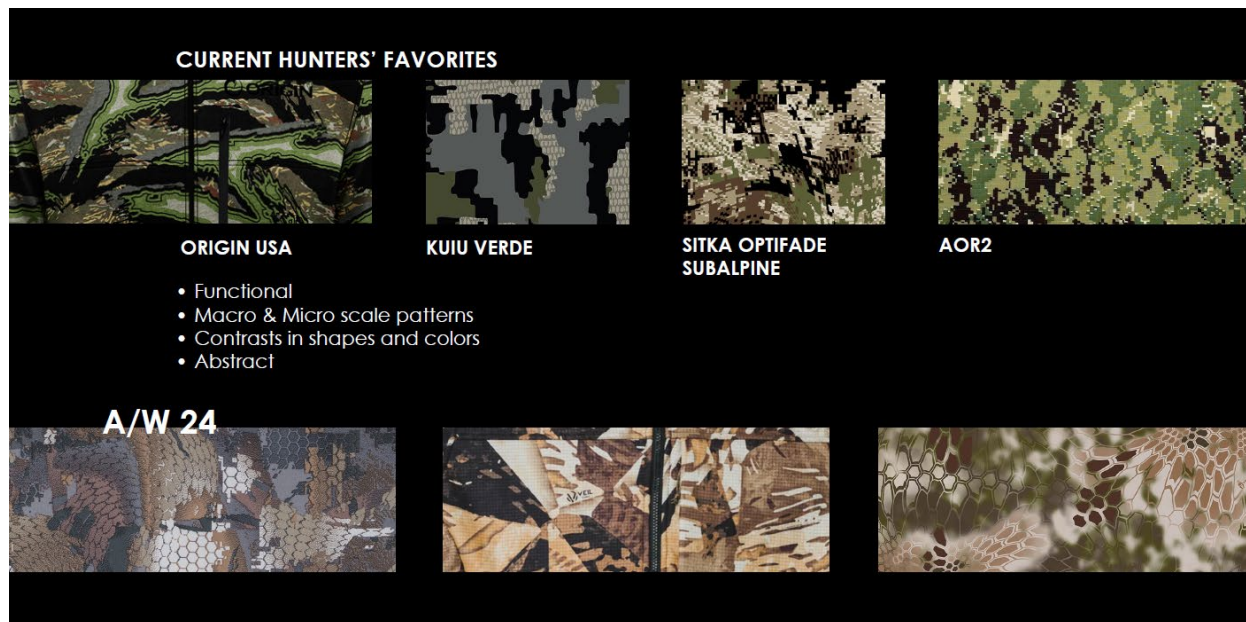


Figure 16 Analysis of camo patterns

While color is crucial for blending hunters into the environment, the choice of graphics also plays a vital role in breaking up the human pattern and seamlessly integrating with the environment's shapes and textures. In the current landscape, camouflage needs to incorporate both macro and micro-scale patterns to offer the best possible concealment (KUIU, 2023). According to experts, "First, it must avoid stimulating the ambient system. Essentially, that means breaking up the hunter's 3-dimensional shape, not just the silhouette, which must be achieved with an effective macro pattern. Second, if the hunter is detected, the camouflage must prevent or delay recognition by making the hunter appear to have a completely different texture, which is where the micro pattern comes into play." (Sitka Gear, 2023) This approach can determine the design factors for PNW bowhunters, enabling them to align with graphic trends and reference the offerings of top competitors.

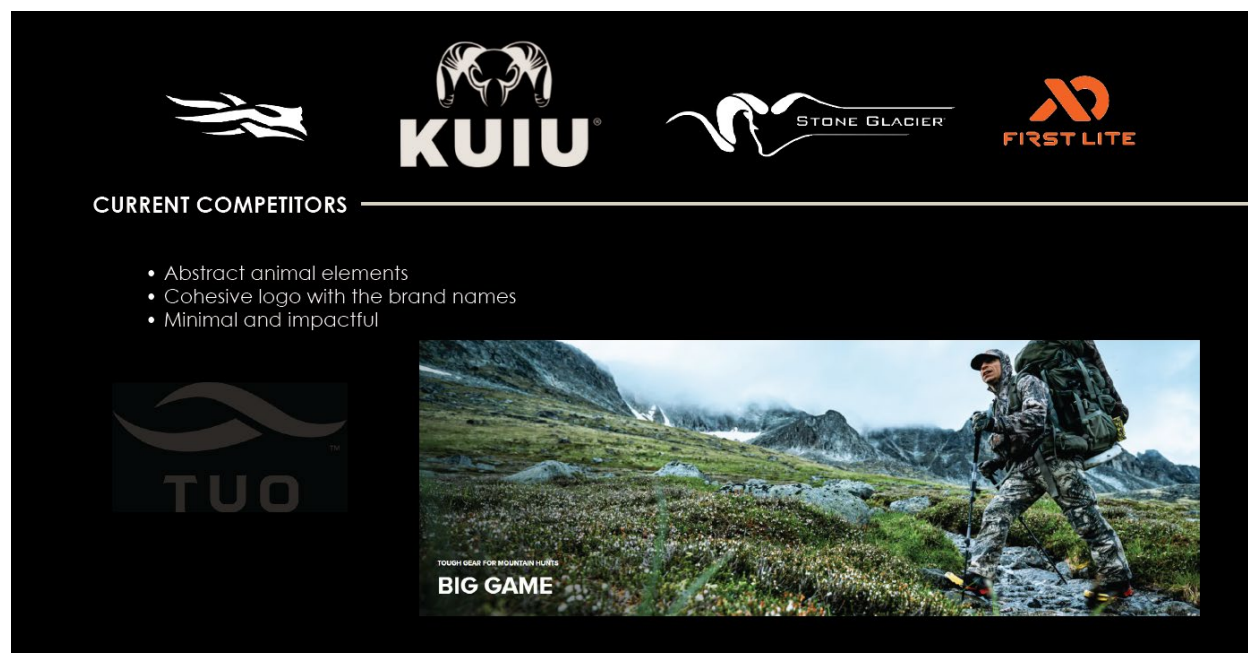


Figure 17 Branding analysis

The contemporary branding landscape within the hunting field is marked by a deliberate emphasis on minimalistic and bold design elements. Notably, brands like Firstsite take a straightforward approach by utilizing logos that closely mirror their brand names. On the other hand, companies such as Kuia and Stone Glacier integrate animal elements, such as big horn sheep and antlers, as a central part of their branding strategy. This serves to highlight their gear's suitability for the challenging conditions found in the habitats of big horn rams. In another dimension, companies like Sitka venture into the use of tribal and abstract elements to create distinctive and impactful branding that resonates with their target audience, adding a layer of depth and symbolism to their brand identity.

The collection, after research and in-depth discussions with hunters, will be called Converge. Converge derives its name from the convergence zone weather patterns that occur in the PNW region. Convergence weather happens when air comes together and rises, cooling and

forming clouds, which can lead to precipitation like rain. The name also refers to the way gear and clothing converge to assist hunters in these unpredictable conditions in early September.

Physiology of Hunting

Bowhunting imposes distinctive physiological demands on the hunter's body, encompassing both physical and mental aspects, especially relevant in the context of Pacific Northwest (PNW) big game hunting. The pursuit often entails prolonged periods of physical activity, including walking, stalking, and waiting, necessitating significant endurance. This exertion elevates heart rate, accelerates breathing, and induces muscular fatigue, contributing to the overall physical strain encountered during a hunting expedition. For instance, in multi-day hunts, a single night of sleep may not suffice for recovery, underscoring how a hunter's endurance often dictates the outcome of a hunt, influencing their ground coverage compared to the extensive territories traversed by wild game, which can cover up to 10 miles per day.

Moreover, the stress inherent in the hunt triggers the body's adrenaline response, heightening senses and potentially affecting accuracy during critical moments, thereby directly influencing psychological responses. The connection between bowhunting and primal human instincts is highlighted in an article discussing human nature and historical biological evolution, affirming that such instincts trace back to our hunting ancestors (Haugen, 2023). Understanding and adapting to these physiological intricacies are essential for hunters engaging in PNW big game pursuits, ensuring a holistic approach to both physical and mental preparedness in the challenging hunting environment.

Biomechanics of Hunting

Bowhunting demands intricate biomechanics, necessitating precise control over the bow hand and drawing hand throughout various phases. In archery, where strength and endurance are paramount, maintaining a well-balanced and reproducible shooting movement is critical for accuracy. The six-phase shooting sequence, including bow hold, drawing, full draw, aiming, release, and follow-through, provides stable sequences ideal for studying motor control and skill development (Srinivas, 2017).

In the biomechanics of the bow hand, optimal control during the aiming phase is pivotal, emphasizing the use of bones over muscles. Consistency in archery relies on aligning forces between the archer, bow, and arrow. The shoulder's stability, position, and range of movement significantly influence the bow's exerted moment, emphasizing the importance of a stable and repeatable shoulder position.

The biomechanics of the drawing hand underscore the significance of the line of force passing through the bow hand, drawing hand, and drawing elbow for efficient bow weight management. Proper posture and muscle engagement, especially in the trapezius and biceps, are crucial for minimizing muscle use and promoting a straight line between joints for accuracy (Srinivas, 2017).

Repetitive motion in archery, particularly during bowhunting, is crucial for accuracy, especially when facing exhaustion in the critical moment of aiming at the game. Biomechanical precision, including anchor points such as nose on the string, release hand anchor on the face, and elbow position, becomes essential for successful shots under these conditions.

Psychology of Bowhunting

Bowhunting requires a delicate balance of physical preparedness and mental resilience. Beyond the meticulous tuning of equipment and honing of shooting skills, the true test emerges in the fleeting moments when a single shot defines the entire season. This emphasis on the mental aspect is underscored by personal experiences of missed opportunities due to lapses in the mental game (Casper, 2019).

In the realm of bowhunting, success extends beyond scouting and physical fitness, delving into the realm of mental resilience when it comes to executing that crucial shot under intense pressure. The pursuit of a mental edge involves pushing boundaries in training, shooting practices, and daily cognitive processes. The significance of intense physical training, exceeding the ordinary routine, becomes evident as it contributes to heightened mental strength, simply put, physical and mental discipline can ensure the accuracy and confidence of the hunter. It is key to emphasize making every shot count which aligns with strategic approaches such as visualizing shots and extending comfort zones in shooting distances, reinforcing the interconnectedness of physical and mental preparedness in the intricate world of bowhunting (Casper, 2019)

Prioritizing the mental strength of bowhunters emerges as a crucial element in hunting success, involving the incorporation of positive imagery to ward off target panics and sustain endurance during extended hunting days. To enhance bowhunting experiences and achievements, hunters must engage in thorough preparation before the hunt, encompassing both physical training and the cultivation of a mental edge. In terms of gear selection, comfort and familiarity with equipment play pivotal roles. Confidence in gear usage is paramount, and gear that aligns with the hunter's preferences fosters assurance, enabling them to navigate hunts with confidence. The correctness of features in the gear significantly contributes to this confidence, ensuring a

seamless and distraction-free hunting process. By addressing these aspects, bowhunters can elevate their overall hunting experience and optimize their chances of success.

Research Methods Plan

In the research phase of the project, the emphasis was on understanding hunters and their environments. Approaching the athletes involved in surveys and in-person interviews, allowing for a firsthand look at their gear to better comprehend the unique challenges hunters encountered. For instance, understanding body movements during hunting, noise levels, and the techniques used to mount bows was crucial for the project. The second round of research was concentrated on observing the environments where the gear will be used, such as the mountains and forests of the PNW. This aims to highlight and understand the points of contact, ultimately enhancing the design features of the rain shell and hunting pack.

- September-October: Interviews and Gear check with hunters who just finished their hunts.
- October-November: Send out Surveys & continue on interviews and getting feedback from hunters on how their gears performed.
- November-December: Collect data and make changes as results needed.
- December: Visit prototype makers, manufactures, documentations on hunting trip, collect data and photos of gear performance on the field.

Research survey link: https://oregon.qualtrics.com/jfe/form/SV_dhF1DcVXrb08XUW

SWOT Analysis of Competitors

This analysis examines the existing bowhunting gear and evaluates the impact of various components in jackets, pants, and hunting packs on a bowhunter's performance during a Pacific Northwest big game bow hunt. The focus is on assessing their effectiveness in concealment, heat management, and bow carriage. The objective is to identify strengths, areas for improvement, and potential opportunities and challenges to enhance the seamless functionality of bowhunting equipment in this specific context.

In the realm of jackets, we have three distinct products: Sitka Gear's Dew Point Jacket, Kuiu's Chugach TR Shell, and First Lite's Vapor Storm Lite. The analysis delves into key aspects—main fabric, hood designs, pockets, and venting mechanisms—as these elements form the crux of challenges to address in jackets, specifically related to stealth and ventilation.

The fabric employed across the three brands consists of waterproof materials. Notably, the stretch woven fabrics stand out for their advantages, allowing for movement and presenting a quieter face compared to Gore-Tex shells. For instance, the Chugach jacket utilizes Toray Primeflex Nylon 6/10, 50D as its face fabric. However, weaknesses lie in noise and breathability. Typically, jackets are mono material, lacking diversity or zoning for maximum breathability. This represents an area for improvement in addressing noise and enhancing breathability.



Figure 18 Jacket swot analysis diagram

Examining hood designs across competitors, the predominant approach involves horizontal and front cinch mechanisms to facilitate maximum mobility when worn. Nevertheless, challenges arise in terms of hearing and breathability, particularly in the neck region when the hood is inactive.

Turning to pocket designs in jackets, most feature a backer but lack a lining to dry wet hands. However, they are strategically placed above the waistband for accessibility even with a bag on. It is crucial to recognize that pocket placement needs strategic consideration based on bowhunters' requirements and sizing for specific items.

As for jacket venting, the current design incorporates pit zips that can be fully opened without a backer, effectively avoiding rainwater. However, this requires user movement and

activation. An opportunity lies in zoning the jacket, particularly on the back panel, by employing different materials.

In the realm of pants, many utilize the same fabrics found in jackets. The waistbands feature user-friendly cinch-down mechanisms seamlessly integrated into the pants' designs (KUIU, 2023). This not only minimizes bulk but also enhances comfort. However, recognizing that some hunters may prefer to use their own belts, it's prudent to consider incorporating belt loops into certain designs to accommodate customization according to individual needs.

Currently, reinforcement on rain pants is limited to the interior of the cuff, neglecting the knee portion crucial for users navigating challenging terrains. To address this, thoughtful consideration should be given to reinforcing areas where it can reduce weight while providing ample impact protection and comfort, possibly even offering a removable option.

Ventilation in pants, as discussed earlier, typically relies on human activation, introducing potential issues such as noise in the field. Exploring new opportunities for ventilation involves creating auto-venting features that maintain waterproofness. This innovation would enable users to naturally ventilate as they move without relying on zippers or snaps, thereby offering a more seamless and comfortable fit.



Figure 19 Pants swot analysis diagram

While many current rain pants lack pockets due to their rain shell design intended for outer layer use during glassing, it's worth considering redesigning. The emerging concept for Pacific Northwest hunters involves an integrated system worn in the field. Thus, reimagining pockets and incorporating them into rain pants can be a valuable enhancement, aligning with the needs and preferences of hunters in this region.

Hunting packs play a crucial role for bowhunters, serving as a vital gear carrier throughout the day, accommodating essentials like scouting scopes, first aid kits, water filters, food, water bottles, GPS/electronic devices, field dressing kits, and extra clothing or padding for warmth or specialized hunts. Notably, contemporary hunting packs are also designed to transport game meat.



Figure 20 Pack swot analysis diagram

Examining the predominant fabrics used in most packs, Cordura ripstop nylon or heavy-denier nylon is commonly chosen for its durability. However, a prevalent issue is the inherent noise associated with these fabrics. Hunters often resort to using quieter materials or tapes in specific areas where noise is problematic. This project presents an opportunity to explore fabric selection, introducing different materials in designated locations.

The hardware in packs typically involves snapping mechanisms that can create unnecessary noise, especially when dealing with bow carrying and removal. There is an opportunity to integrate a bow-carrying system while addressing the noise produced by hardware, presenting a valuable avenue for improvement.

In terms of pocket design, most packs strategically placed pockets for different hunting needs. This project aims to explore how pockets can be better integrated into the hunter's

experience, allowing for efficient transfer of bow and binocular-accessible products while wearing the pack.

Lastly, while many hunting packs prioritize back support, ventilation is sometimes overlooked, particularly in high-humidity climates with moisture management challenges. Designing a system tailored for big game bowhunters in the Pacific Northwest requires learning from existing products. It is essential to keep a focus on stealth, modularity, and bow-carrying capability to create a pack that aligns with the specific needs of hunters in this region.

Research Goals & Survey Questions

The survey questions aim to comprehend how big game bowhunters in the PNW experience their hunts. The goal is to understand their product usage, discern the intentions behind their usage, and identify instances of misuse in some gear. Additionally, the survey seeks to grasp the current product landscape to analyze other competing products that may have been overlooked. Furthermore, it allows hunters to provide feedback through images, ensuring accurate mappings of issues in clothing from noise and breathability standpoints. Overall, the objective is to guide the project in the right direction, addressing gaps and solving problems effectively.

Q1 - How many days do you bow hunt each season in the PNW Coast range?

The goal of this question is to comprehend hunters' duration in the woods concerning gear durability and to understand user scenarios.

Q2 - In your experience, how common is it to encounter wet and rainy conditions while bowhunting in the PNW?

This question aims to determine the frequency of waterproofness required to assess the gear's needs.

Q3 - How important is staying dry and comfortable while bowhunting to your overall performance and enjoyment?

The objective is to understand the gear's value when designing for intended features.

Q4 - What types of rain shells or waterproof outerwear do you typically use while bowhunting?
(Brand, Product name)

This follows up on current research to better understand competing products and their responses, allowing for a fair analysis.

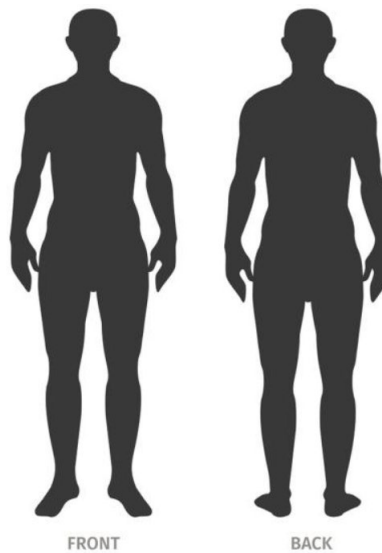
Q5 - Have you ever experienced discomfort or reduced performance while bowhunting due to moisture and sweat accumulation inside your rain shell in wet or rainy conditions? Please describe your experiences.

This is a follow-up to the previous questions to understand users' problems with their current rain shell, providing direct user feedback without testing.

Q6 - Select crucial rain shell features or benefits you think can contribute to successful big-game bowhunting.

These answers can guide the design, understanding the hierarchy of features and benefits to prioritize in later design.

Q7 - Click on the parts where you sweat the most while wearing a shell (Pick 5)



This image choice of heatmap options allows users to pinpoint where their problems lie with sweating, providing the designer with a direct approach to solving the issues.

Q8 - Click where you feel the shell noises bother you the most. (Pick 5)

This can help the designer understand noise issues and where to look for problems, as well as understand why fabric choices can heavily affect the noises.



Q9 - How do you carry your bow when hunting? (Explain the usage process)

This helps designers understand current solutions and potential improvements that can better integrate users' experiences while hunting without distractions.

Q10 - What would you change about your current hunting pack, feel free to elaborate.

To better understand how different styles of hunting packs can be used in users' scenarios and how they are not meeting their needs.

Professional Statement

Golden Circle Statement

Why: Fueled by a passion for mitigating risks and enhancing human performance in outdoor environments to harmonize the human and natural world

How: By implementing cutting-edge technologies, design process & materials.

What: Create user-centered designs that seamlessly integrate human experience with the natural world, inspired by the backcountry gear he uses and the diverse aspects of the sports he enjoys.

Personal Strengths and Project Correlation (*Cliftonstrengths 2023*)

1. Ideation
2. Maximizer
3. Analytical
4. Responsibility

5. Adaptability

Reimagining gear for PNW big game bow hunting as a project will require my strengths and enhance them accordingly. The project aligns with my strengths because it demands high levels of innovation, solution, and ideation to achieve optimal results and create products that effectively address challenges. The sport of hunting itself necessitates a person to be a sportsman, encompassing analytical thinking, maximizing resources, being responsible as a hunter to the environment, and adapting to different conditions and elements to come. Therefore, by undertaking this project, it perfectly aligns with my strengths.

Enhancing gear for PNW big game bow hunting integrates my strengths though ideation propels innovation, fostering inventive solutions tailored to the unique challenges of PNW bowhunting. Maximizer refines each design element, optimizing efficiency to surpass conventional norms. Analytical thinking ensures a methodical approach, grounding solutions in data for a deep understanding of PNW bowhunting challenges. Responsibility adds an ethical layer, aligning solutions with responsible hunting practices and environmental considerations. Adaptability ensures flexibility in response to dynamic PNW conditions. Together, these strengths create a targeted toolkit, uniquely equipped to address the diverse challenges of enhancing gear for a more effective and ethical PNW big game bow hunting experience.

This project will serve as a testament to my ability to apply creative thinking, maximize solutions, analyze problems deeply, take responsibility for impactful design, and adapt to diverse challenges. These skills are highly transferable and will position me as an asset in the

hunting/design industry, particularly in product innovation and problem-solving roles, and in some cases design directive roles.

Travel Plan

The hunting trip's plan goal is to observe and gather feedback from athletes. The primary focus of the expedition will be on identifying issues related to moisture management, noise, and bow carrying during the hunt. In all, deepens the understanding of how these factors significantly impact the hunter's experience and pursuit of the game. This includes testing competitor products to assess their performance in the actual hunting environment. The information collected will be instrumental in enhancing knowledge and improving equipment and techniques utilized in this demanding sport.

Agenda

Late Season Over the Counter Oregon Deer Hunt

Tag cost: \$45

Duration: 2 Days 1Night (Dec 6- Dec 8)

Hotel: \$180

Day1:

6:30 am - 8 am: Driving to trailhead and breakfast.

8 am - 12 pm: Hike in from the parked car/camp

Observe sweat progression, rain gear inspection (noise, moisture, hearing)

Decibel meter

Bow carrying feedback

Pack capability/day pack/meat carriage

12 pm - 2 pm: Lunch + glassing

2 pm - Sundown (5 pm): Active movements till sundown, spot, and stalk

Stalking: Observe noises, contacting points with the gears and surfaces, utilization of the pockets, bow, and fitment of the jacket when in shooting position.

Gear feedback at the end of the day.

Back to camp.

Day2:

8 am - 12 pm: Hike into vantage point

Glassing. Sporting (Repeat observation & documentation)

12 pm - 5 pm Active Spot and stalk

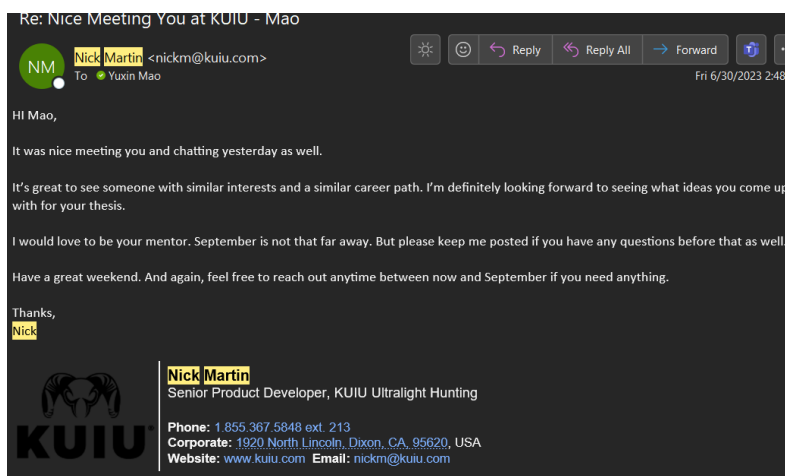
The overall duration of field research should guide the design process and inform additional research necessary for understanding usage challenges. This involves utilizing the collected data to prepare for competitor testing in the lab and analyzing it to enhance the design of the new hybrid shells and hunting pack.

Project Mentorship

In this PNW Bow Hunting Gear Project, I will have 2 different mentors. One Senior product developer (Nick Martin) from KUIU Ultralight Hunting Gear, and the other is a Product Lead (Amy Roberts) from Sitka Gear. Both are extremely valuable to the project and personal development from design and innovation standpoints. The mentors have in-depth experience

specialized in the hunting industry, that will elevate and keep this project in line with the industry standard.

- **Amy Roberts:** Product Lead at Sitka Gear, 20+ Years in Outdoor Industry
She provides resources from prototype makers, hunting experts as well as materials advantageous to the project. Meeting once every two weeks and text communication for any other information.
- **Nick Martin:** Senior Product Developer / Hunter



Nick is a great person to seek out and have for materials questions, pattern specific, and other technical questions in the phase of prototyping. Meeting once every month or 2 weeks for check-ins and questions in prototyping and choices of materials.

Testing Plans

The testing plans are going to focus on moisture management, stealth (sounds & visual), as well as bow carrying capabilities. In this plan, there will be testing done to the current competitor products as well as the work alike prototype for comparisons.

Competitor Products:

1. Sitka Gear Dew Point Jacket:

- Link: [Sitka Dew Point Jacket](#)
- Price: \$349
- Size: Medium

2. Sitka Gear Dew Point Pants:

- Link: [Sitka Dew Point Pants](#)
- Price: \$329
- Size: Medium

3. Sitka Mountain 2700 Pack:

- Link: [Sitka Mountain 2700 Pack](#)
- Price: \$529
- Size: Medium
-

Performance Metrics for Data Collection:

1. Stealth in Sound and Visual:

- Sound Decibel Level: Measure gear noise during movement.
- Visual Camouflage: Evaluate gear's visual blending in PNW environments.

2. Moisture Management:

- Water Resistance Test: Measure water height and pressure.
- Drying Time: Weight reduction in drying capability.

3. Breathability:

- Breathability Index: Inverted cup test.
- Fog Machine Test: Calculate fog escape percentage in camera frame.

4. Swift Bow Carrying and Access:

- Bow Retrieval Time: Measure time to access and draw a bow.
- Ease of Movement: Evaluate gear's comfort and agility.

Testing Procedures:

1. Sound Decibel Test:

- Step 1: Collect decibels from walking motion with jackets and pants separately.
- Step 2: Collect data inside the jacket hood, playing constant sound outside the hood.
- Step 3: Compare data inside and outside the hood to understand hearing capability.
- This test will be conducted with human subjects wearing the jacket while sounds are being recorded, and the test will receive the best results in a sound room to achieve accurate data.

2. Visual Test:

- Step 1: Set up a camera in a fixed forest spot.
- Step 2: Place competitor and prototype in the same spot.
- Step 3: Take photos in different environments for hunter evaluation.
- This test will take place in the PNW coast forest environment, conducted in the field without the need for a human subject. Photographs will be taken and analyzed in software. The end results will involve comparing photos and presenting them to hunters for rating, determining the effectiveness of the new design.

3. Breathability Test:

- Step 1: Set up fog machine with jacket and pants propped up.
- Step 2: Start the machine and record fog escaping from the garment at different angles.
- Step 3: Record fog escaping from jacket and pants against a contrasting background.
- Step 4: Analyze photos after a fixed time frame and calculate fog escape surface area.
- This test will not require a human subject; however, data will be collected through photographic documentation to better understand the ventilation properties of the two different jackets. This process aims to assess the amount of breathability allowance to compare the two jackets' ventilation properties.

4. Bow Access Test:

- Step 1: Set up gear for the tester.
- Step 2: Record time from putting the bow in reserve mode from the ground.
- Step 3: Record time from bow on the back to access in hand ready to nock.
- Step 4: Record the time of bow from hand to the back of the pack in reserve mode.
- This test will measure time-related data and involve a user. It aims to assess the effectiveness of bow access and carry ability, comparing it with the current product. By evaluating the time taken, it will determine whether the new product enhances usability.

The testing plan for the PNW Big Game Bowhunting Gear project assesses moisture management, stealth, and bow carrying capabilities. Competitor products like Sitka Gear Dew Point are compared with a work-alike prototype. Performance metrics include sound decibel, visual camouflage, water resistance, drying time, breathability, and bow retrieval time. The tests involve human subjects in a sound room for accurate measurements, field testing in the PNW coast forest with photos for evaluation, and fog machine and photographic documentation for breathability assessment. Time-related data is collected with a user for the Bow Access Test. These tests aim to uncover strengths and weaknesses, guiding design improvements for user-centered, high-performance gear tailored to PNW big game bowhunting challenges.

Survey Results

Here are the correlated questions along with summaries of their survey results. The data were gathered from diverse sources, including archery shops, Cabela's customers, and online hunters. The data was collected between 11/8/2023 and 12/1/2023. In total, there were 11 respondents, all of whom possessed experience in hunting with a bow in the Pacific Northwest during archery season.

Question 1 (Q1) - Bowhunting Frequency: The survey revealed that respondents typically spend 2.13 days bowhunting each season in the PNW Coast range. The majority, 50%, reported spending seven or more days, indicating a significant commitment to the sport.

Question 2 (Q2) - Encounter with Wet Conditions: Regarding encountering wet and rainy conditions, 80% reported frequently experiencing such weather while bowhunting in the PNW.

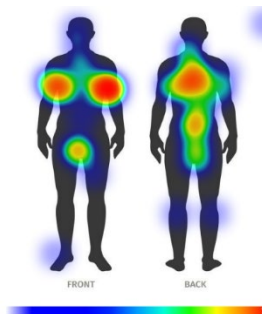
Question 3 (Q3) - Importance of Staying Dry: Staying dry and comfortable was deemed important to overall performance and enjoyment, with a mean score of 65.56 out of a possible 100. These results can be a reflection of how other elements may be more critical for the hunters on field success.

Question 4 (Q4) - Rain Shell Preferences: Respondents provided a range of rain shells and waterproof outerwear brands they typically use, including First Lite, Gore-Tex, Columbia, and Sitka. All are within the competitor landscape.

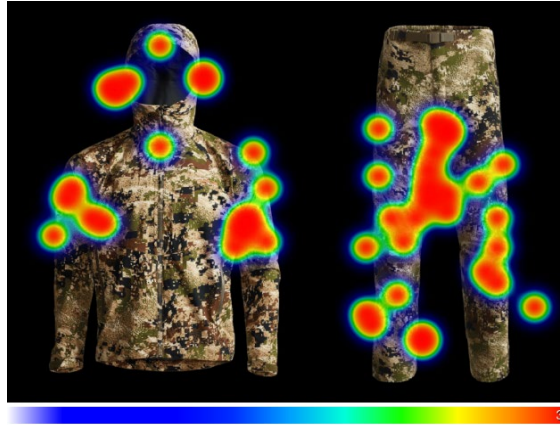
Question 5 (Q5) - Discomfort Due to Moisture: Some respondents reported discomfort and reduced performance due to moisture and sweat accumulation inside their rain shells during wet or rainy conditions. Issues included decreased body temperature, wet interiors, and difficulty drawing bows.

Question 6 (Q6) - Crucial Rain Shell Features: The most valued rain shell features for successful big-game bowhunting, according to respondents, included breathability, waterproofness, quiet fabrics, and durability.

Question 7 (Q7) Respondents have offered valuable insights into sweat zones when hunting in the PNW coastal environment. This underscores the significance of identifying specific areas that require attention and addressing these issues. The data illustrates the concentration of these areas, emphasizing that encountering this problem is a common occurrence.



Question 8 (Q8) Respondents have provided insights into the sources of most noises, guiding the conclusion that the new design for the region should prioritize improvements in noise comfort.



Question 9 (Q9) - Current Bowhunting Packs: Respondents mentioned a variety of bowhunting packs, including Exo, Mystery Ranch, Kifaru, and Eberlestock.

Question 10 (Q10) - Bow Carrying Methods: Responses varied on how hunters carry their bows, with methods ranging from holding it in hand to using slings and straps.

Question 11 (Q11) - Feedback on Current Packs: Suggestions for improvements on current hunting packs included considerations for size, weight, noise reduction, and secure bow storage.

Conclusion: The results underscore the importance of factors such as weather conditions, rain shell performance, and gear preferences for PNW bowhunters. Armed with these insights, I gain a clearer understanding of existing product challenges, enabling me to enhance features and improve overall benefits for hunters. These findings will steer my ongoing research efforts, with a specific focus on refining gear designs to better address the distinctive challenges confronted by bowhunters in the Pacific Northwest.

Competitor Product vs Converge Prototype Testings

To advance the design process, competitor product testing is conducted to gain insights into areas for improvement, identify potential weaknesses in apparel and gear, and understand how different gear components interact in the field.

Currently, tests are being conducted on Sitka's Dewpoint shell system and Mystery Ranch's Pop-up 38 hunting pack. Three specific tests are being conducted to assess noise levels during movement, sound transparency, and bow accessibility.

Noise Reduction in Movement

The first test, Noise Reduction in Movement, aims to evaluate the performance of the current rain shell in terms of sound levels measured in decibels. This information helps designers identify areas where noise reduction is necessary to enhance the new product. The test is conducted in a sound booth, where simulated stalking movements, such as joint rotations, knee bends, full bow drawing, and rotation with packs on, are recorded using a decibel meter to measure the average sound volume.

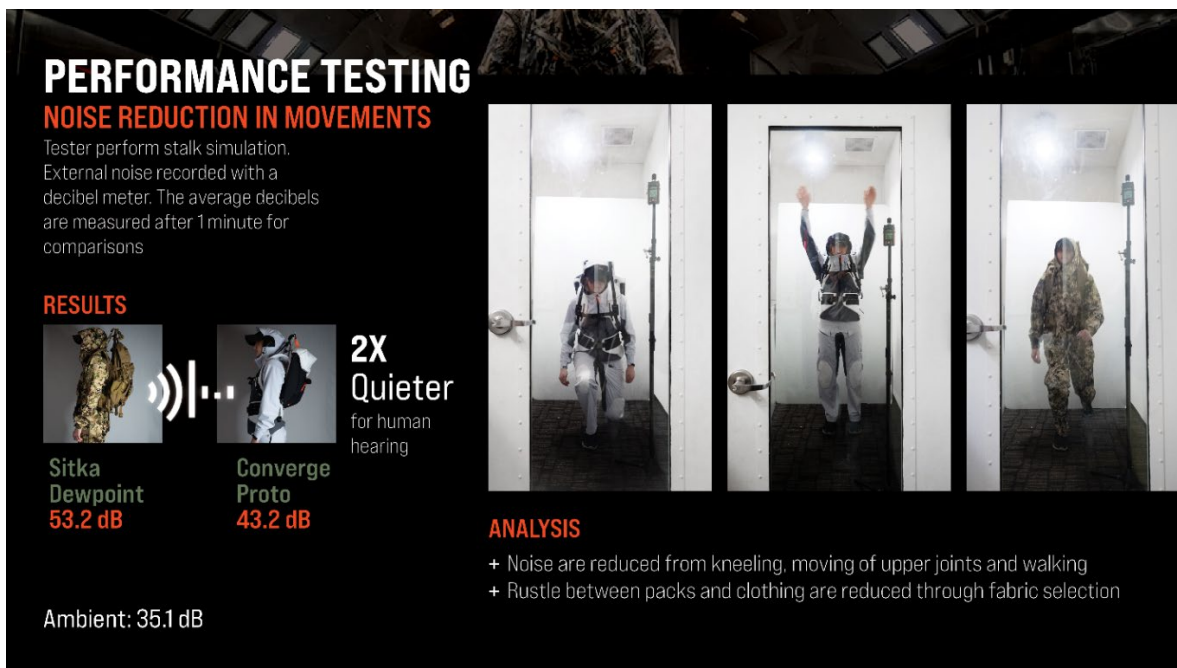


Figure 21 Noise reduction test.

Data:

Sitka Dewpoint System:

Trial 1: 45.7 dB

Trial 2: 60.3 dB

Trial 3: 53.6 dB

Converge Proto:

Trial 1: 43.0 dB

Trial 2: 43.1 dB

Trial 3: 43.5 dB

Analysis of the results reveals that most of the noise emanates from buckling sounds of the current rain shell, rustles during walking motion, and arm lifting for full bow drawing. The

average sound output of the competitor product after three rounds of testing is 53.2 decibels, representing an 18.1-decibel increase from the ambient level of 35.1 in the sound booth. Overall, the Converge prototypes are quieter by 10 decibels.

Acoustic Transparency of the Hood

The subsequent test aims to measure the sound transmission through the competitor's hood vs the Converge prototype AMP hood, which is a new design from the Converge collection. Assessing how fabric allows the sound to pass through, along with rustling against hair and skin affects hearing while wearing the hood. This test is also conducted in the sound booth, with an ambient decibel level of 35.1 decibels. A test tone at 200Hz, relevant to the frequency of the human voice, is played, and decibel levels are controlled through a speaker to ensure consistency in both competitor and prototype testing.

Results indicate that the current Sitka Dewpoint shell hood allows 45.5 decibels to be received by a wired mannequin head, with an average noise level of 64 decibels when rustling against the skin. In comparison, the AMP hood allows an average of 50.3 decibels to be received and produces an average noise level of 52 decibels when rustling against the skin.

Sitka Dewpoint Jacket Hood:

Trial 1: 43 dB

Trial 2: 43.4 dB

Trial 3: 44.1 dB

Converge Prototype AMP hood:

Trial 1: 48.0 dB

Trial 2: 50.5 dB

Trial 3: 52.4 dB

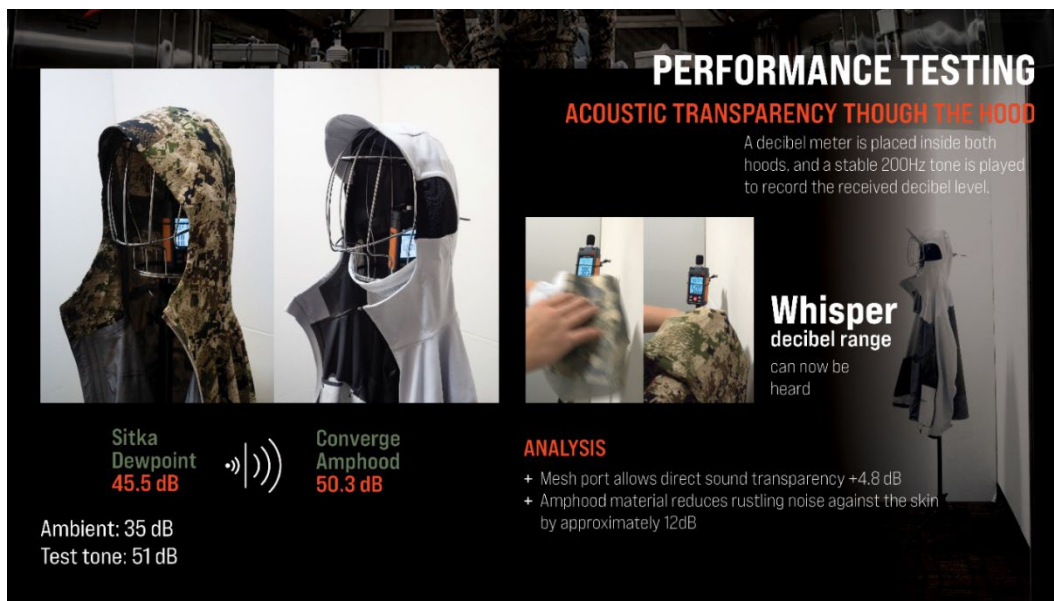


Figure 22 Hood Hearing Test

Data reveals that with the new Amp hood design from the Converge prototype, hunters can now hear an additional 4.8 decibels through the hood. However, the most significant difference in the data is the substantial reduction of rustling noise from competitive fabrics by 12 decibels with the new 3D spacer mesh. Consequently, while users wear the hood, they will hear more external sounds due to less noise covering them.

Bow Accessibility Test

This next test focuses on bow accessibility, which is crucial in hunting environments where quick access to the bow can make all the difference in critical situations. The test is conducted in a controlled indoor environment with suitable lighting and ample space for maneuvering.

The objective is to record time trials of how quickly a bow hunter can retrieve their bow from the pack and go into a full draw, comparing it to the Bow-tack hardware designed for the

Converge system. The data will validate that the new Bow-tack hardware provides better accessibility for hunters compared to the current solution.

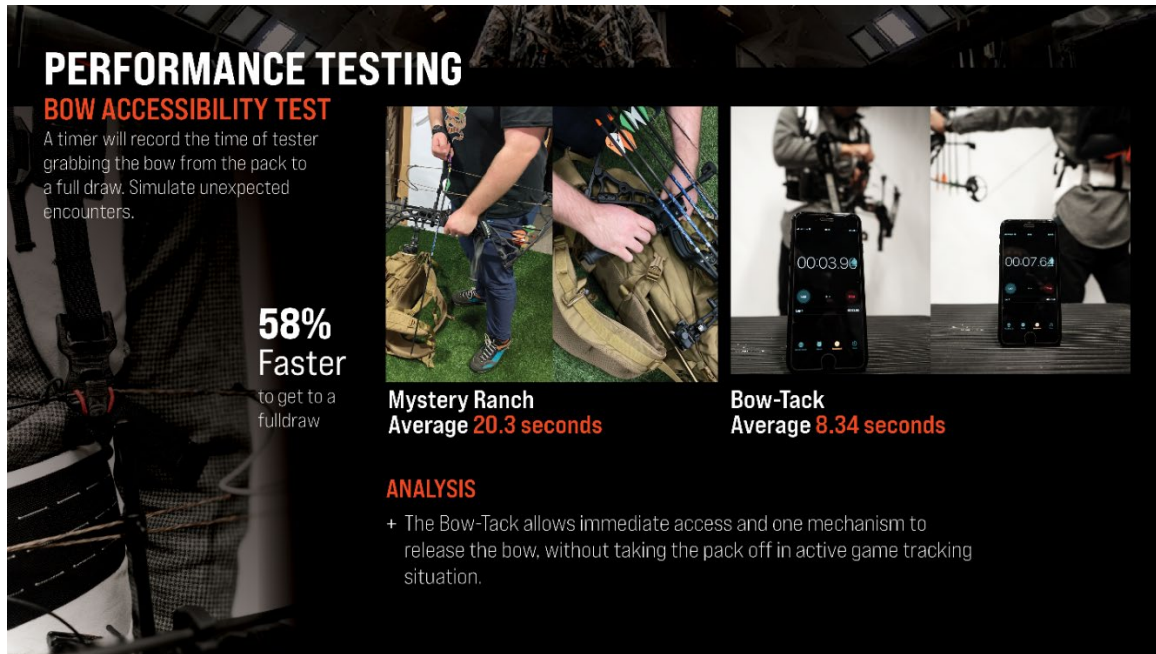


Figure 23 Bow Accessibility Test

Mystery Ranch Pop-up 38:

Trial 1: 18.5 s

Trial 2: 19.0 s

Trial 3: 20.5 s

Trial 4: 21.0 s

Trial 5: 22.5 s

Bow-Tack:

Trial 1: 7.5 s

Trial 2: 8.0 s

Trial 3: 8.2 s

Trial 4: 8.4 s

Trial 5: 9.6 s

Results show that, on average, it takes testers 20.3 seconds to retrieve the bow from the pack and go into a full draw, while the Bow-tack reduces this time to an average of 8.34 seconds. The new Bow-tack design eliminates the need to remove the pack and unbuckle the straps before picking up the bow. Now, hunters can access the bow in half the time and maintain focus on the game. Overall, it provides hunters with a hands-free bow-carrying option and immediate access.

Prototyping Process of Apparel and Pack

After completing thorough competitor product testing in sound and bow accessibility, designers now possess a profound understanding of the metrics to exceed while tackling the primary challenge of unlocking the potential of PNW bowhunters for stealth and endurance. This entails harmonizing clothing and gear to optimize field harvests and encounters.

To kickstart the prototyping phase, sketches, and ideation transition seamlessly from digital concepts to physical prototypes through platforms like sketching and CLO3D. This 3D apparel design software ensures precision in tailoring designs to user size, motion, and fitment.

Design concepts are propelled by the objectives of enhanced venting, noise reduction, and improved hearing. This entails a reimagining of pattern design to enhance fit during movement and incorporate sustainable material zoning. Given the necessity for users to wear packs and gear cinched around the torso, the primary focus lies in jacket design, emphasizing breathability through mechanical venting and strategic material choices to eliminate the need for hunters to unzip for ventilation.

While maintaining the paramount importance of stealth in hunting gear, fabric selections are guided by sound tests to pinpoint properties and zone placements for targeted noise reduction in areas of frequent movement.

Transitioning from digital ideation to physical prototypes, the process undergoes nine different pattern designs before final execution. Iterations occur on seam construction, bonding, and laser cutting to meet hunters' needs effectively.

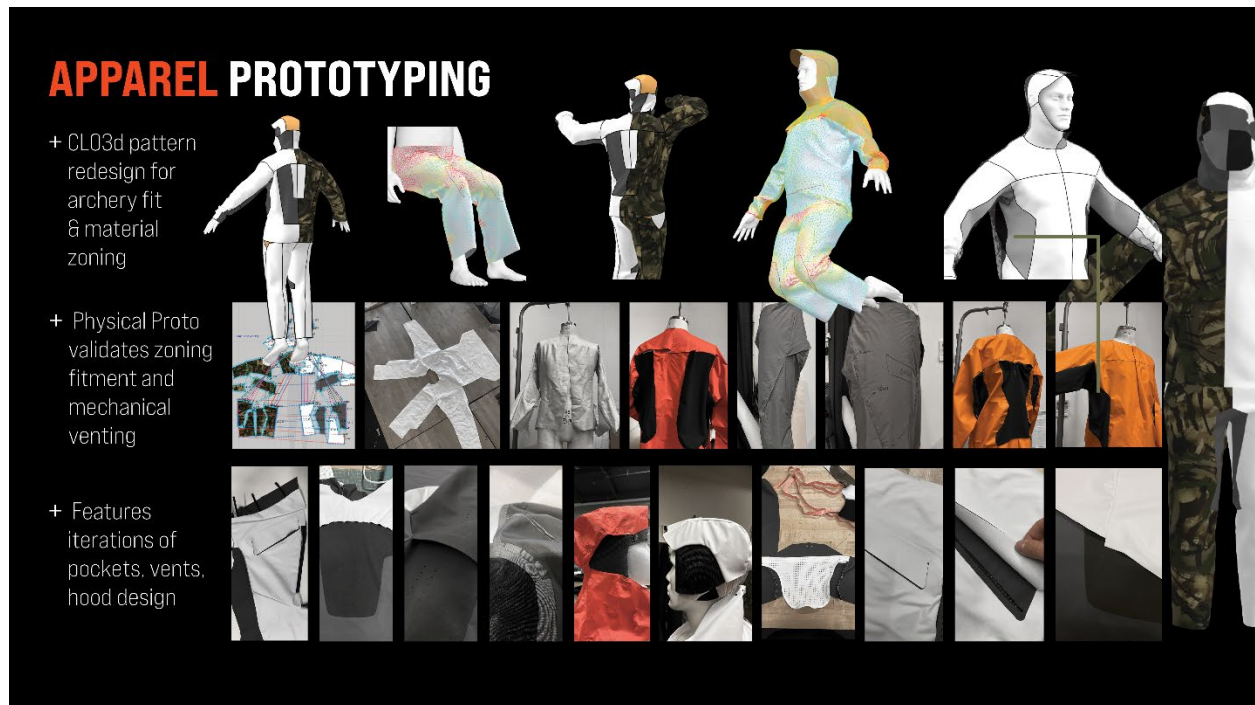


Figure 24 Apparel Prototyping

The pack prototyping process commences with frame design and draping straps to achieve an ideal fit for hunter meat hauler needs. Patterning revolves around enhancing comfort by expanding surface areas and providing strategic support, while reducing material in areas requiring breathability.



Figure 25 Pack Prototyping

A significant focus of pack iteration involves improving bow accessibility. This entails designing adaptable and durable hardware for versatile bow placement, ultimately streamlining the design to achieve better weight balance and easier access to essential items for the hunter. The new hardware concept is developed using Rhino and 3D printed with PETG for wear testing.

Work-Like Prototype Overview

The Converge jacket, pants, and pack are showcased in the images below, highlighting features essential to the hunter's experience in immersive environments. Each product plays a crucial role in ensuring optimal performance for the hunters.

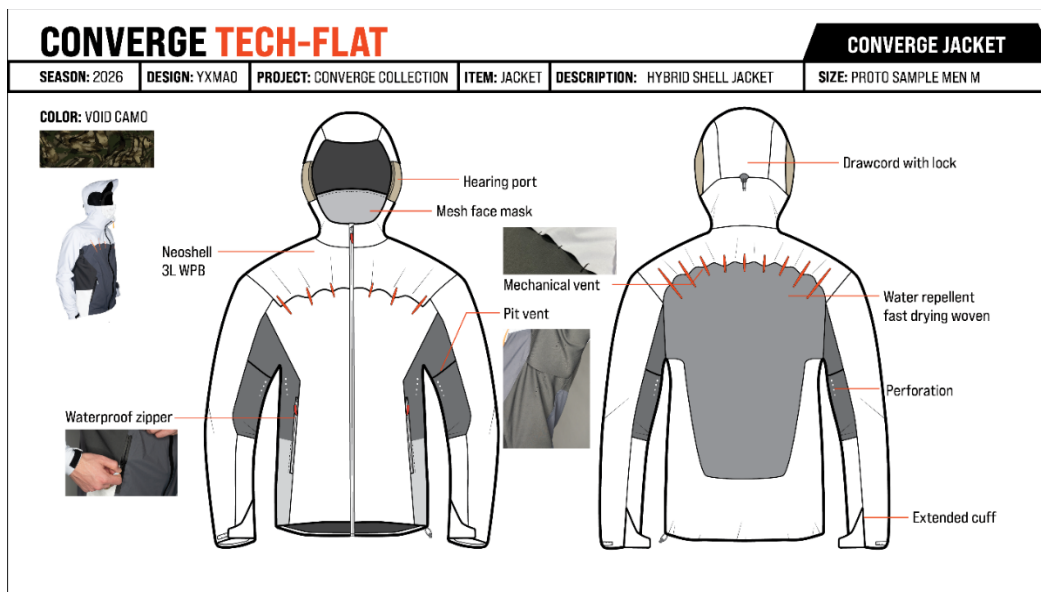


Figure 26 Converge Jacket Flats

The Converge apparel features similar zoning, with water-repellent, highly breathable stretch woven fabric utilized in key areas such as the underarms, crotch, and back panel. This allows for adequate breathability while maintaining protection. Mechanical venting is strategically built into the front and back panels to increase airflow, while underarm vents provide additional articulation when arms are raised, enabling the bowhunter to move more freely while maintaining a streamlined profile. The hood design enhances the hunter's ability to hear, and the cinch-down mechanism on the mask allows the hunter to maintain their line of sight. Additional features include a brushed face mesh pocket for drying hands, a cinch cord for waist adjustment, and extended cuffs to prevent bowstring strikes. The Converge pants offer four pockets designed for all-day comfort and utility, with quiet zipper less pockets and sufficient rainproofing for enhanced wearability in various conditions. Overall, the apparel is designed to help hunters focus on the hunt while providing necessary performance features.

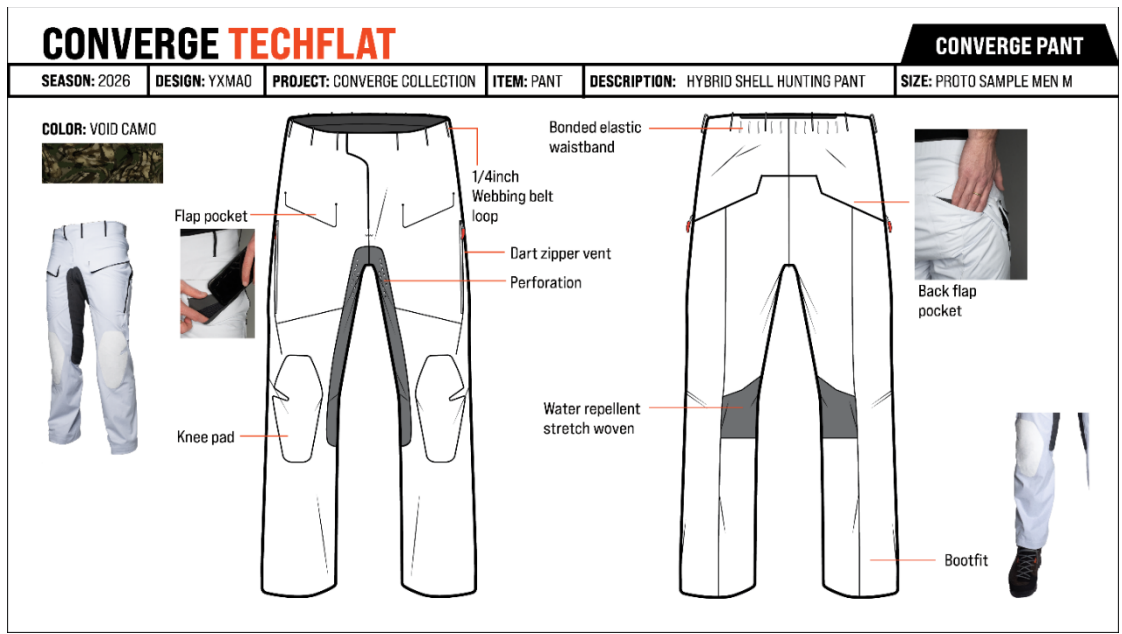


Figure 27 Converge Pant Flats

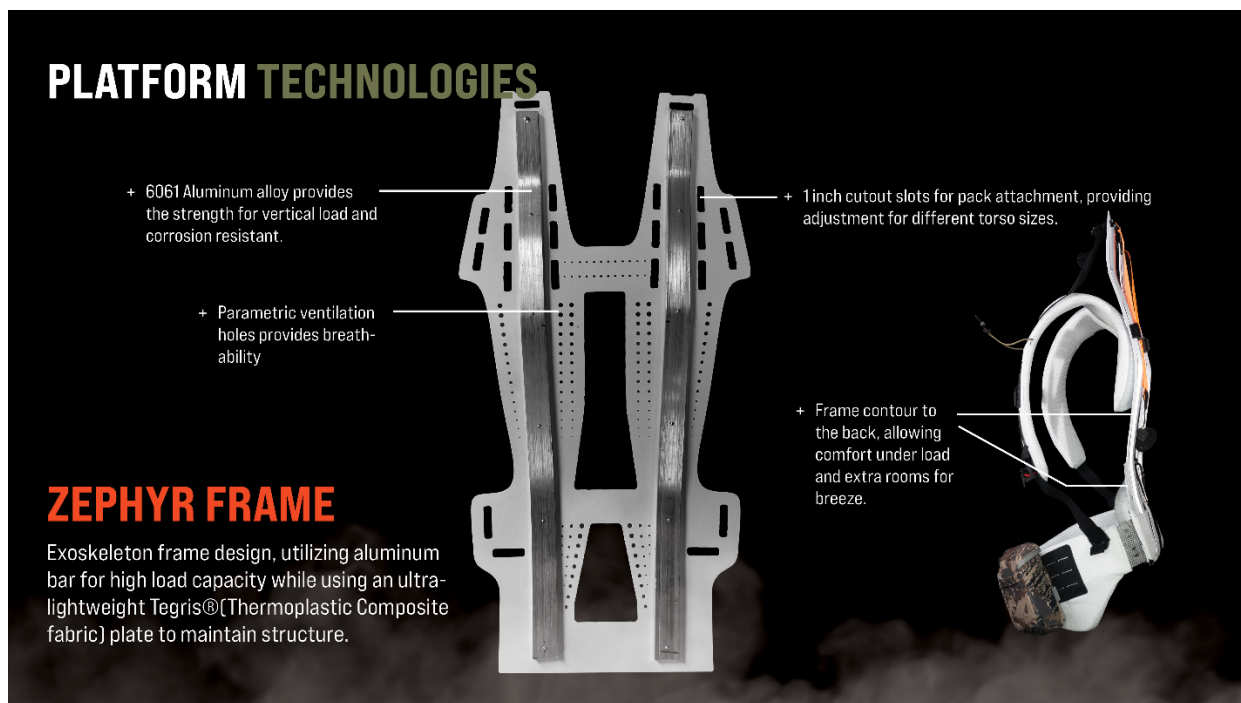


Figure 28 Zephyr Frame

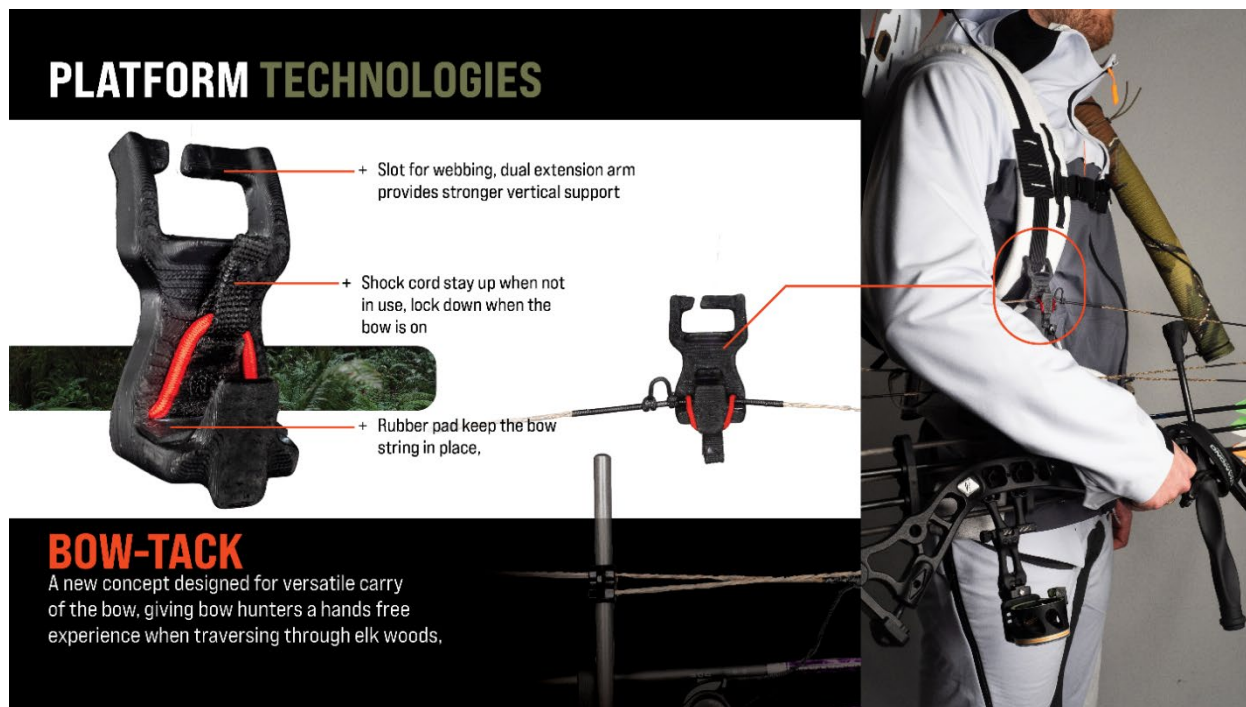


Figure 29 Bowtack

The Converge pack is designed with three modular sections: the strap system consisting of shoulder straps and a hip belt, the Zephyr frame, and the dual day pack. Together, these components provide meat-hauling capability, ample storage, and comfort for intense, fast hunts. The pack straps feature newly incorporated shock cord for holding game calls, vertical webbing for attaching various accessories, and MOLLE laser-cut slots on hip belts and shoulder straps for customization according to each hunter's specific needs. The Zephyr frame is crafted from 6061 aluminum alloy for vertical load strength, while the thermoplastic panel offers flexibility for free body movement. Perforations in the panel allow seamless integration with the jacket, and slot cutouts accommodate different torso sizes. The day pack features an ultra-quiet microsuede WPB3L rain lid with magnetic closure for waterproofness and easy access. Side zips provide open access to the rest of the pack. Meat-hauling compression cords are configured in a lacing pattern to distribute weight evenly, with high-denier fabric supporting the load alongside a Y-

strap for vertical compression. In essence, the pack offers a minimalist approach for PNW bowhunters while retaining utilitarian features.

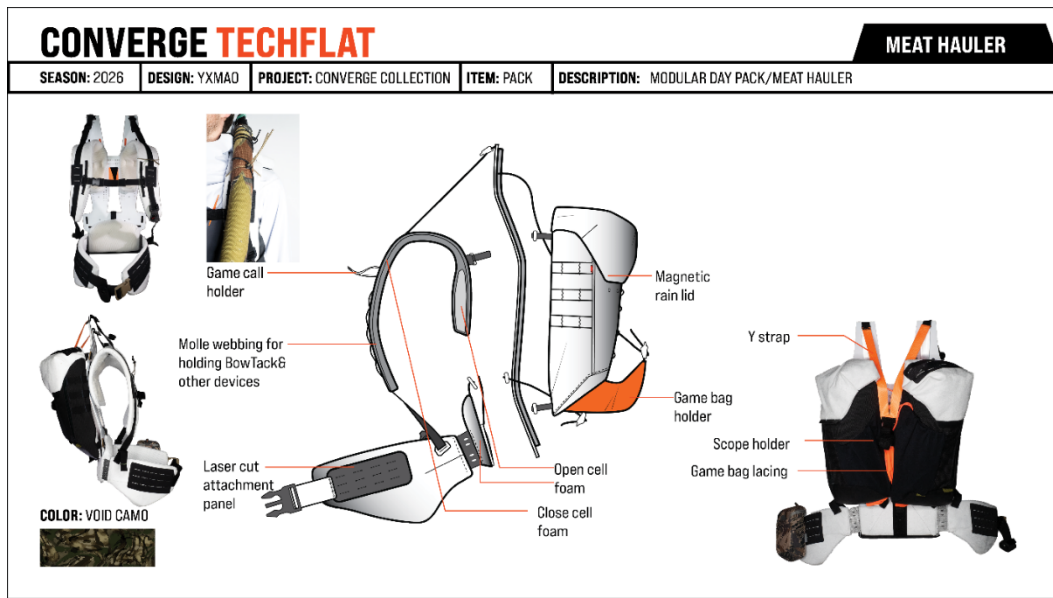


Figure 30 Converge Pack

Final Prototype Overview

The final prototype is designed to meet the needs of Pacific Northwest big game bowhunters, showcasing refined and updated features based on testing and feedback from bowhunters and experienced hunting guides. The image below highlights some of the feedback received on the work-in-progress prototype and the improvements made in the final version.



Figure 31 Athlete feedback

Several immediate changes were made for the final prototype, including camouflage printing. The Converge camo is sublimation printed on most trims and fabrics throughout the collection, including zippers, bias tape, and 3D spacer mesh, which helps conceal hunters in their designated environments. New features designed to enhance bowhunters' performance include a forearm cinch cuff that slims down the garment where the bowstring typically interferes. The updated hood now incorporates a gasket to cinch it onto the wearer without the need for adjustment. Additionally, the hood's brim uses a new adhesive from Bemis that maintains its shape while eliminating the crinkly noise common in most hoods on the market. The back panel's

venting has been redesigned; the section in contact with the pack uses fast-drying stretch woven fabric, while other vented areas are free from external pressure.

In the pack redesign, updates include the use of fabric in the external pocket, which now features a hybrid of power mesh and durable knit for ventilation and drainage of gear such as spotting scopes. The main fabric is printed like the apparel, with microsuede laminated to a Gore-sponsored invisible fit backer for abrasion resistance and waterproofing. The shape of the meat shelf, which holds the package with vertical compression, has been redesigned with a triangular design to better conform and distribute the weight load, working seamlessly with the Y strap. Updates based on athlete feedback to the shoulder straps focused on streamlining the bow drawing process by flattening features and providing storage options for the bugle caller. A new style of sternum strap allows hunters to adjust without slack interfering with the bow drawing process. The wind checker slot is also strategically placed to avoid motion interference.

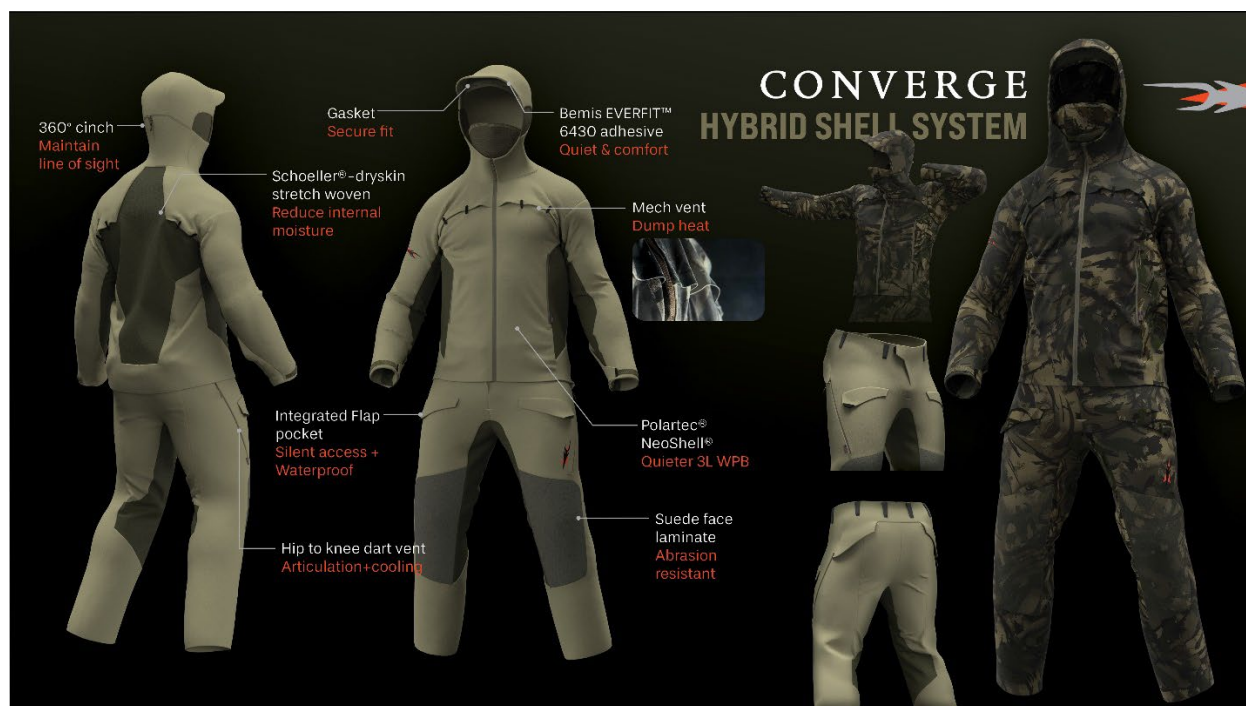


Figure 32 Overview of Converge Hybrid Shell



Figure 33 Overview of Converge Speed-Hauler

Conclusion

In summary, this project and the Converge collection have enabled a deeper understanding of Pacific Northwest (PNW) bowhunters and provided them with the proper gear for early-season big game hunting. Through user and market research, designers identified gaps in existing clothing and gear. Lab and field testing allowed for improvements in design and materials, addressing the challenges of bowhunting, which can be more demanding than alpine sports. Unlike the rapidly advancing mountaineering gear, hunting gear has lagged behind. This project aims to unlock the potential of both athletes and products, introducing innovative solutions to assist hunters and inspire advancements in other industries with cross-functional

elements.



Figure 34 Converge collection photography



Figure 35 Converge collection photography 2

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