WILDERNESS SAR

PARKRANGERS, MOUNTAIN&CAVE RESCUE,WATER&HELI-OPS

ISSUE 5

WILDERNESS SAR

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ON THE COVER

Ski Patrol using Team Wendy's M-216 specialist Ski SAR helmet. Because we don't have either, our review on page 36 skates over the use of the top-mounted MOHOC camera (right) or the marker-light beacon shown top-left. Both utilise the clear frontal section of the shell which is the perfect place to attach the mounting plates - either using 3M adhesive tape and Velcro or rubber straps as shown here. MOHOC

and Team Wendy have tied up with a mutual purchasing deal (discount to customers of either) because the MOHOC, as a ruggedized, military grade camera capable of being submersed to 10m/30ft is so well suited to the M-216 and Exfil SAR, the other helmet we will be reviewing this year.

Lose Volume, Not Strength

[ED: Not a shampoo but a great rope although I'm not entirely sure that 5.7lbs/100ft or 65g a metre is any lighter than most modern 11mm ropes. What it does do though is give you a stronger rope for the same weight – most 11mm ropes are around 3000 to 3500kg minimum breaking strength so 4000kg is pretty good.]

Stronger • Lighter • Less Volume • Superior Knotability Introducing the NFPA, G-rated 11 mm rope, made from traditional fibers. This low-stretch Kernmantle rope constructed with a polyester sheath and nylon core offers maximum strength in a lightweight and easy to handle rope. G11™ Lifeline is ideal for rope rescue and access operations providing enhanced safety, performance and superior knotability.

FEATURES
Available in lengths of 150ft, 200ft, 300ft, and 2,400ft. (custom lengths available)
4 color options (Red w/ Gray, Blue w/ Gray, Orange w/ Gray, Yellow w/ Gray)
Made in the USA
Kernmantle Construction with Polyester Sheath / Nylon Core
Knotability = 0.6
Elongation (Per UL Classification)
3.0% @ 1.35kN (300 lbf)
5.5% @ 2.7kN (600 lbf)
7.9% @ 4.4kN (1,000 lbf)
Elongation @ 10% of MBS= 6.0%
Weight: 5.7 lbs/100 ft
Certification: NFPA 1983 General Use
3-sigma MBS (Per UL Classification): 40kN (8,992 lbf)
Diameter 11 mm (7/16")
COST: 200ft – $210
WEB: www.cmcpro.com

NEW DESCENDERS

[*ED: a bold move for a market you would think was pretty saturated in this more access-related section of descending hardware. These are really a variation on Kong's existing Indy model so perhaps more of an 'upgrade' than a new design, new in 2018 that is, we're a bit behind. Nevertheless, we never can resist a new descender, ascender or pulley so here they are. The Pirata is a single brake action kinda like the Petzl Stop with a GriGri style sprung, articulating handle while the more rescue oriented Indy Evo Plus has a double brake action and a similar handle. Both have easy rope take in so can be used as your second ascender in access manoeuvring and as a non-return locking 'pulley' in raising systems.*]

PIRATA

Descender designed for rope access and work positioning. New design significantly reduces friction during ascent. The cam system perfectly aligns the rope in a single plane, limiting twisting during long descents. Simplicity of construction facilitates pre and post use checks and simplifies periodic inspection. The stainless steel cams have a long life, even with the most intense use. The new articulated lever allows release to be driven by the user's body weight, thus reducing the required force necessary when compared to a traditional brake lever. Suitable for skilled and experienced users.

INDY EVO PLUS is a manually operated descender device with double autolocking system, that locks both when the lever is released or when it is pressed. Indy Evo Plus is also a descender (conform to EN 12841 type C) for working on rope. It allows descent at a controlled speed, stopping at any time, hands free, on a static rope (EN 1891) or dynamic rope (EN 892). Light weight and compact size, long life guaranteed by the stainless steel cams and low maintenance make it a working tool very appreciated by the industry. Certified for two people, it allows two people to lower at the same time and also allows the user to take in rope slack.
High quality products, made in Italy!

	PIRATA	INDY EVO +
STANDARDS	EN12841/C	EN341 EN12841/C NFPA
WEIGHT	420g	480g
HEIGHT	174mm	190mm
ROPE DIAM	10-12	10-12
WLL	100-200kg	100-200kg
MBS		14kN
APPROX COST	$151/€135	$180/€160
WEB	www.kong.it	

PETZL ID 'EVAC' Specifically for lowering

[*ED: One of three new versions of the iconic ID auto-locking decenders (plus a new Rig). This one orientates better in the reversed lowering mode and has additional friction posts which we understand can also be purchased separately to retrofit other (new) ID descenders]*

The I'D EVAC self-braking descender is primarily designed for lowering from an anchor. The ergonomic handle is specifically oriented for managing of a load from the anchor and offers comfortable descent control. The integrated anti-panic function and anti-error catch limit the risk of an accident due to user error. The AUTO-LOCK system allows the rope to be automatically locked without having to manipulate the handle or tie off the device. Once locked, the rope can be taken up without having to manipulate the handle. The safety gate allows the rope to be installed with the device remaining connected to the anchor. I'D EVAC is compatible with 10 to 11.5 mm ropes and allows handling of loads up to 250 kg.

Cost Approx $285-$299/£213 inc VAT www.petzl.com

EDELRID VERTIC

Triple-Lock and Easy Glider

[*ED: 'Multi-use' rescue harnesses try to be all things to all branches of rope rescue – from heli-rescue to confined space to mountain/wilderness and industrial fire-rescue but few, if any really cross the divides. This one may be no exception as it's relatively heavy with so much hardware but it does have many features to make it worth a look if you need a full body harness to deal with more than one operational remit]*

The Vertic Triple Lock is a fully-equipped body harness, work-positioning harness and sit harness with a multitude of innovations and detail. Two models: one with Easy-Glider buckles, one with Triple-Lock buckles in the leg loops. The harness is easy to put on and take off from the side (using a Cobra buckle). Need not be pulled over the head.

- The vertical backstraps run sideways over the hip. This ensures maximum freedom of thigh movement and bending of the upper body
- The waist belt is fixed to the vertical back-straps with a VCR fastener. This means that heavy loads can be optimally transferred to the shoulder straps
- Three-dimensional leg-loop design with elastic inserts for maximum freedom of movement and optimum comfort
- Covered buckles protect the webbing from premature wear at exposed points

- Quick and easy handling of tape ends (even when wearing gloves) thanks to a stopper seam before the end stop
- Two fall arrest eyelets in accordance with EN 361 (dorsal fall arrest eyelet flexibly mounted to prevent snagging in shafts or narrow passages)
- Two gear straps with click buckles on the back of the waist belt for attaching ore equipment (e.g. first aid kit)
- Four rigid gear loops for up to 12 carabiners (Load: 25 kg)
- Central eyelet according to EN 813 for attaching hardware
- 2 large aluminium D-rings as side eyelets in accordance with EN 358 provide a work position and a stand-by position for fastening a lanyard
- One attachment option for the SM clip on each leg loop (load: 0 kN)
- 2 central loops for attaching a work positioning seat (Air Lounge)
- 2 freely positionable gear loops (load: 0 kN)
- 2 loops on the chest harness for attaching a radio set
- Sizes S-M or L-XL
- Weight: 1.6-1.7kg / 3.5-3.75lb
- Cost: *-approx €361/£372/$500*

www.edelrid.de

SWIFTWATER RESCUE GLOVES

Swiftwater rescue can be extremely cold and demanding work. That's why we've made NRS Reactor Rescue Gloves extremely warm and tough. When lives are on the line, you'll want these gloves on your hands. Reactor Gloves feature 3 mm neoprene with titanium laminate adhesive to provide maximum warmth when you're working in cold conditions. The palm and fingers are constructed with super tough aramid material that provides tenacious grip for rope handling and other demanding physical work. Fingers are pre-curved to relieve hand fatigue while gripping paddles and ropes. Seams are glued and blind-stitched for durability and warmth. PowerSpan™ 4-way stretch fabric provides increased finger mobility. GripCote™ on the backs of the fingers helps prevent wind chill and evaporative cooling.
A soft strip of fleece on the side of your thumb and forearm is perfect for wiping the sweat from your brow after a successful rescue. Wristband with hook-and-loop closure ensures a secure fit. Rubber bite tab on the wrist assists with donning, even when your hands are wet. Pairing snaps on the wrists help keep the gloves together.

MATERIAL: 3 mm neoprene
SEAMS: Glued & blind-stitched
PALM MATERIAL: Aramid
WRIST CLOSURE: Adjustable hook-and-loop strap
GENDER SIZING: Men
FEATURES:
PowerSpan™ backing on neoprene
GripCote™ patches on fingers
Fleece strip on thumb and wrist
Wrist pairing snaps
SIZING: S: width 3 1/4" Length 7". M 3 1/2" 7 1/2"
L: 3 3/4" 7 3/4" XL: 4" 8"
XXL 4 1/2" 8 1/2"
COST $54 www.nrs.com

FORCE 6

Modular... everything

[ED: nothing particularly new about the Force 6 RescueTec ($299) other than additions to the modular accessories and we've included it before in TECHNICAL RESCUE but this was our old Water Rescue Editor Jim Segerstrom's favoured PFD so it's good and it deserves some regular PR as one of the smallest but truly specialised rescue companies].
The RescueTec is our top-of-the-line PFD. It is designed for water rescue professionals and public safety teams that find themselves in extreme situations.
The RescueTec fits the swimmer like a glove with its two sizes, eleven adjustments and extendible waist belt on the LG/XL models. Optional leg swim harnesses help prevent flush drownings. If you are swimming in moving water to save lives, the RescueTec is your PFD.

- 26lbs, 11.8 kg of flotation
- US Coast Guard Type V Professional certified
- Large armholes allowing a full powerful stroke
- 11 Adjustment straps – custom fit
- Quick release belt for throw bag attachment on right & left
- 420 Denier high tenacity nylon
- Molded extraction handle
- 4" hook & loop ID panel on back
- Heavy duty YKK front entry zip
- Reflective SOLAS tape front and back
- Extendible waist belt (LG/XL)
- Colors: red or black

ACCESSORIES: RescueTec Right and left Pocket $39 USD ea.
Extrication Leash $64 Universal Back Pocket $54
Scissors Pouch $29 RescueTec Swim Harness $22
Dart Throw Bag $64 Dart Throw Bag Belt $29

www.force6.com

Rescue & Tac Medical Modules Simplified

SURVITEC STANDARDISES ITS PRE-HOSPITAL CARE SYSTEM MODULES TO ADVANCE IN-FIELD TREATMENT

Safety and survival equipment supplier Survitec has standardised its entire portfolio of battlefield casualty sustainment modules to reduce the number of fatalities sustained from injuries that are generally considered to have been treatable.

Adopting an approach implemented by the US military, Survitec has reconfigured its 29 medical modules, including the FC-1, MC-1, FC-2, FC-4, FC-4WP, FC-5WP and CS-2 pre-hospital care systems, to ensure that all personnel, irrespective of the level of training, can administer effective treatment with confidence.

Kevin Wheeler, Group Medical Director, Survitec, said: "Each module has been re-designed by our specialist team of SOF medics and rescue professionals to maximise user interface, speed of care and mobility of equipment."

The optimised pre-hospital care system delivers modular capabilities for several different trauma scenarios including extraction, field mobility, tactical field care, tactical evacuation care, sustainment care, mass casualty care, far forward environments, CBRN environments and naval operations.

A key development is that all components have been standardised with a comprehensive suite of medical equipment placed in order of the severity of the possible injury sustained.

"Entry level-personnel with limited medical knowledge can quickly administer the care relevant to the injury," said Wheeler. "This provides all combat personnel with full life saving capability, from in-field patient access to hand-over at the hospital."

All modules are packed by Survitec following strict guidelines, delivering confidence to end-users that all the equipment they carry is present, within its use by date and working correctly.

Wheeler said: "Supply chains in the military often take a long time and can sometimes result in the armed forces being behind the curve in terms of access to new technologies and equipment. One of the advantages of the Pre-hospital Care System Modules is that forces can get access to standardised up-to-date equipment, which helps bridge the gap between older equipment and newer technologies. With standardised components it is also easier and quicker to replenish spent consumables."

The principle behind Survitec's medical modules is in line with the US Special Armed Forces Tactical Combat Casualty Care (TCCC) programme introduced the mid-1990s to reduce the amount of preventable deaths on the battlefield.

Wheeler said: "It is about empowering soldiers with training and equipment to do something about casualties on the battlefield."

Another aspect of Survitec's care package optimisation has been the introduction of a protective casing for the Philips Lumify handheld ultrasound system, which is included in the Pre-hospital Care System to help diagnosis and treat casualties.

Responding to requests from the Norwegian military, Survitec and Royal Philips subsidiary Remote Diagnostic Technologies (RDT), a UK-based innovator of advanced pre-hospital health monitoring solutions, pooled their resource to develop a shield capable of protecting the critical equipment in a combat scenario.

The Norwegian armed forces use Tempus Pro patient monitor system as standard across all its forces and invited the companies to develop a case to protect it on the battlefield.

Following the collaboration, all Philips Lumify ultra sound devices are now supplied with a robust casing inside a man packable medical module (a backpack that can be carried by one man). It now features as part of its PCS (Pre-hospital Care Systems) Modules.

Norway currently uses Survitec PCS Modules across all its armed forces and the product is also on trial with special forces in other countries.

web: survitecgroup.com

WHITNEY PACK gets an Upgrade

The updated Whitney Pack in this 2.0 version includes upgraded storage capacity and organization, and a more durable fabric in a new color. Designed by rescuers for rescuers, this is the perfect SAR-ready pack. Large enough to carry gear and provisions to support you in the field for a multi-day mission, the Whitney 2.0 contains plenty of pockets and features to keep everything well organized and easily accessible.

- Volume 2,800 CI (46 L)
- Weight: 6 LB 2 OZ (2.81 KG)
- Redesigned suspension system for maximum comfort
- Dividable main compartment adapts to fit larger items and can be accessed from the top or bottom
- Includes a detachable rainfly and ground cloth, which are stowed separately
- Fabric density is 1000 denier for improved durability
- Fleece lined stowage for goggles/glasses
- Redesigned compartment for better organization:
  - Water resistant pouch
  - Multiple mesh zippered pockets
- MOLLE and reflective strips for higher visibility
- Shove-It-Pocket for easy and secure access
- Durable and water resistant material at bottom and side pockets reduce wear and abrasion
- Available in OD Green
- COST: $225

www.cmcpro.com

K9 PPE

[ED: A trio of K9 PPE from Ray Allen Manufacturing in Colorado Springs which, at 70 years, must be one of the oldest dog-outfitters in the world? The cooling vest is one of at least half a dozen models now available for dogs. Originally developed for combat personnel we trialled a very effective rescue version many years ago also using CoolPax – despite the 'lighter-than-water' claim, weight was a consideration once the cooling aspect is expended because it's deadweight until you can recharge it in a freezer or cold water but hopefully it will have served it's purpose on a hot day's searching by then.]

MUTT MUFFS

Your dog can now enjoy full-spectrum noise reduction with the comfortable, lightweight Mutt Muffs. This ear protection specifically engineered to meet the contour of your dog's head is perfect for helicopter and airplane noise, but reduces harmful noise in nearly any environment. This item works great for working dogs and pets both. COST: $55

Made in the USA. Available in three sizes in black color. Measure your dog's head at the largest point for circumference.

- Medium Size is for dogs weighing 20-50lbs, with a head circumference of 13-18 inches
- Large Size is for dogs weighing 50-95lbs, with a head circumference of 18-23 inches
- X-Large Size is for dogs weighing 95lbs and more, with a head circumference of 23 inches or larger

Note: Dogs should always be supervised while wearing Mutt Muffs. Care should be taken when your dog is wearing Mutt Muffs in outdoor environments or in circumstances where hearing is beneficial.

REX SPECS

Rex Specs dog goggles are protective eyewear for the active dog. The Rex Specs dog goggles protects your dogs eyes from debris, environmental hazards and harmful rays from the sun. Rex Specs have a stable secure fit that allows full motion of the jaw and full rage of view. Goggles come with 2 lenses 1 clear and 1 blue mirror, both lenses are rated UV400 blocking 99.9% of UVA and UVB rays. The head strap system is fully adjustable to accommodate a range of head shapes and sizes.

Goggle Fitting

- Muzzle Circumference: Between 9-11.5 inches (22-29 cm). Measure your dog's muzzle where the goggle lands on the nose.
- Head Circumference: Between 14-17.5 inches (35-44 cm). Measure the head circumference where the goggle rests on the forehead
- Common Breeds: Belgian Malinois, Dutch Shepherd, GSD, Border Collie, Australian Shepherd, Pointers, Labs, Mutts, Staffordshire terriers, Heelers, retrievers, Dobermans, Greyhound
- Common Weight: Between 40-85 pounds.
- COST $80.00

Replacement Lenses Available including 3 pack of Smoke colored lenses. Polycarbonate, UV 400 lens protect against 99-100% UVA/UVB sun rays. Rated ANSI Z87.1-2010 for impact resistance. 3 for $20.

COOLPAX DOG VEST

The TechKewl Dog Cooling Vest provides hours of cooling comfort and heat stress prevention. The Phase Change Material used in the Cool Pax inserts is non-toxic, non-flammable, durable, reusable, lighter than water, does not produce condensation and releases long-lasting, temperature specific (58 F, 14 C), cooling relief for your dog in high heat environments and strenuous situations. Packs are included. Available in coyote tan color.

For sizing, measure your dog from the base of the neck, at the shoulder, to the base of the tail. Sizes are determined by the length of the dog's back. Measuring from the base of the neck to the base of the tail; 9-12 inches – Medium; 12-18 inches – Large; and 18-24 inches X-Large. $30 **www.rayallen.com**

NO COMPROMISE BLADE

Most multi-tools include a plethora of "tools," many of which are not actually very useful. Even worse, in many of these tools, the important knife blade is an afterthought—and barely useful at all. Not the Select Fire.

The Select Fire was built to be a knife-focused multi-tool. It's built around a manual opening knife blade, a knife blade that simply works and works well. For strength and edge-holding capability, the Select Fire's blade is made of 8Cr13MoV stainless steel and bead-blasted for an easy care, matte look. What's more, the Select Fire offers a surprisingly comfortable grip, so it's actually easy to hold as you use that big, useful blade—something most multi-tools can't say.

Designed by Grant & Gavin Hawk, the Select Fire is also a handy multi-tool. There's a 4-piece bit set, plus the bit driver. The bits, two flathead and two crosshead, are in on-board carriers that swings out to let you choose your bit, then swings back to snap into place. Black liners give it a sleek, finished look. The contoured glass-filled nylon handle is equally comfortable whether you're using the blade or the bits. The Select Fire makes a great addition to every tool and truck box. In fact, it's so handy you might want to get two.

Has multiple blades or tools, enabling it to perform multiple functions.

Manual: There is no mechanical assist, such as SpeedSafe, used to open the folding knife. It opens the classic, old-school way.

Liner Lock: Locks the blade open during use; one side of the knife's steel "liner," the steel plate to which the handle scales are attached, moves into position behind the blade to securely lock it open.

Single-position: The pocketclip is in a fixed position on the knife handle; usually it is positioned for tip-down, right-handed carry, though this may vary.

Reversible: Pre-drilled holes in the handle enable the user to change either the tip position or the side on which the knife carries.

- .25" hex drive, 2 flat, 2 crosshead bits
- Ruler on bit drive shaft
- Manual opening
- Thumb stud
- Liner lock
- Reversible pocketclip (left/right, tip-down)
- Steel: 8Cr13MoV, bead-blasted finish
- Handle: Glass-filled nylon
- Blade Length: 3.4 in. (8.6 cm)
- Closed Length: 4.25 in. (10.8 cm)
- Overall Length: 7.6 in. (19.4 cm)
- Weight: 5 oz. (141.7 g)
- WEB: kershaw.kaiusaltd.com

LED multitools

[ED: Regular readers will know that we have often bemoaned the lack of LED lights in multi-tools, assuming there was some industry reason why such a useful tool was never included. Turns out, it is. Can't vouch for how good the Coast models are but worth a mention given our regular comments on LEDs or lack of. Coast has 7 LED models from the '120', similar in design to the Kershaw above, to a 3"/51mm (when closed) 'Micro', to this one the '150/155' at 4" long when closed which appears to have been recently updated minus the scissors it used to have.]

The LED155 Multi-Tool ($51) has 13 tools that can help you master any task or job. Featuring multiple 2-lumen LEDs, a liner lock blade, among many other tools, it is a must have on your belt or in your toolbox.

- **Spring-loaded pliers with wire cutter,**
- **3.0 in. Blade,**
- **two built-in LEDs; 1 towards pliers, 1 towards knife**
- **Phillips (1) and flathead (3) screwdriver tips,**
- **bottle opener, wire stripper, can opener.**
- **2 x CR1616 batteries included.**

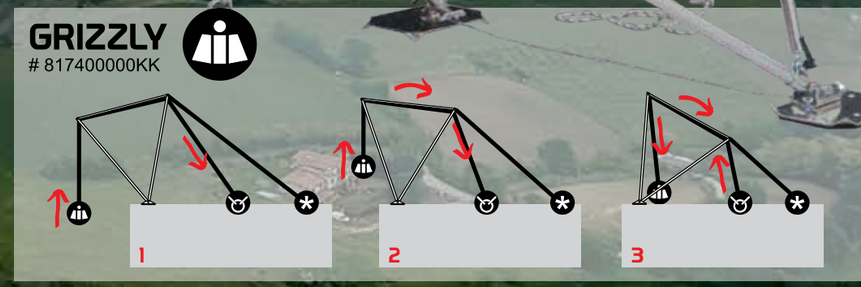
Lifetime warranty against defects in materials and workmanship.

https://coastportland.com

KONG ITALY

www.kong.it

HIGH QUALITY RESCUE EQUIPMENT



available in North America by

KONG USA

www.kongusa.com

GEAR REVIEW

C.A.M.P. LIFT

Ascender & Fall Prevention Device

In our guide to Abseil/Rappel Back Up Devices in TECHNICAL RESCUE issue 72 we had the *Lift* part way down the column looking like it was the largest device in the world (we do state that items aren't to scale) but in reality it's easily one of the smallest. As you can see from the picture on the left, it's smaller than a DMM *Buddy,* CAMP *Goblin,* SAR *Rocker* (and its numerous other namesakes) and certainly smaller than a Petzl *ASAP* so we've shown it against the latest version of a *Rescuecender* instead and even that looks relatively huge. It was in fact the joint smallest in size and lightest in the entire genre at 75mm/3" wide and 95g/oz. Perhaps you already knew how diminutive it is but having only had our hands on the more sophisticated and robust CAMP *Goblin*, despite the fact that *Lift* has been out since the turn of the century, it came as a bit of surprise just how small and light this is. Perfect for the weight-saving wilderness community. And not necessarily because you want it as a back-up device since many won't routinely use a back up rope but because it works so well for other things as well. If you look again at the options on the left, the closest, in mechanical function, and perhaps sheer bulk would be the SAR Products/Troll *Rocker* on the bottom and even that is almost twice the weight.

ORIGIN:	ITALY
COST:	£43 / $55 / €47
WEIGHT:	95g / 3.4oz
MATERIALS:	Alloy cam and casing Stainless locating/ fastening pins
DIMENSIONS:	78mm / 3"wide 68mm / 2.7" High 25mm / 1" depth
EYE:	14mm / 1/2"
ROPES:	8-13mm 5/16-1/2"
STANDARDS:	EN 12841B EN567
WEB:	www.camp.it

CONSTRUCTION

Lift's simplicity is awe-inspiring. It's like they looked at the *Rocker* which is about as simple as things get anyway and thought, we can shave a bit off that, a bit off that, trim that plate and change that cam shape. And so they did. Its size does have limitation though – the *Rocker* at 200kg MBS will cope with a two person load, the Lift is pretty much personal-use only at MBS 100kg. Two alloy side plates are anodized in the now signature matt and oddly glittery finish. The main eye will take up to a 14mm/ half inch bar carabiner and the side plates are kinked to allow them to sit flush to each other at the point of carabiner connection.

GEAR REVIEW

C.A.M.P obviously don't see these devices being used by large metropolitan fire services with their 50kN giant carabiners because both the *Lift* and the *Goblin* have noticeably smaller eyes than all other models.

There is a curved profile cam (2) against which the rope sits and is held in place by a sprung interface (1) which runs the height of the *Lift* and is completely flat on the inner (rope contact) face. It actually runs above the height of the *Lift* because it protrudes by almost 10mm from the top of the side plates. This interface is shaped like a tick (as in, the symbol not the creepy-ass arachnid) with a concave curve on the outer face which allows your thumb a comfortable contact point when releasing the *Lift* to let rope through or move down. The opposite cam (2) has a knurled outer edge (pic left) which wouldn't actually ever come into contact with anything as far as we can tell. It's either decorative or they've nicked a ribbed cam from another device to save some money? Either way it works.

As is the norm these days there is ample information on the front plate – at least there is when it's new. The only bit you really need to take note of is the little man telling you the direction to load it because it is otherwise very easy to load upside down. In this regard there's an image on the inside of the plate as well as the outside.

IN ACTION

Aside from being a more than adequate ascender, albeit over relatively short distances and a good back-up device it's a great lanyard or lifeline adjuster and it's probably smaller than your prusik Purcells! Connect it to your side D-rings if using in a pole-strap mode or to your front connection on the simplest mountain harness designs and use it for edge restraint (safety) with a short rope (pig-tail) anchored behind you. Unlike the *Rocker*, *Lift* doesn't have a 'locking' mode which prevents you from accidentally activating it or more accurately, sliding to an unwanted position while it's unloaded. That's because it holds position when unloaded – those of you used to a free-running back up device won't like that because it needs to be manually pulled down or re-positioned, OK when performing manoeuvres but a pain in the ass when abseiling a series with short to mid length drops. Of course if you're ascending and this is your back up – it's perfect, not least because, if your handled ascenders fail for some unfathomable reason, the *Lift* can step in. Spot the rope join in the photo sequence above?

They say that size doesn't matter but smaller and lighter makes a difference to your pack when you're trudging in for miles or even days on end. You might say that Wild Country's *Ropeman* is just as useful and even smaller and lighter but it doesn't offer the back-up device option at least not officially. The *Lift* is also *much* easier to initiate a controlled release when lifelining or lanyard adjusting because you have both the curved cam to push against and the side of the plate (with the carabiner connected) to push down upon at the same time if you feel the need. Some have stated on 'you-tube reviews' that they can't down-climb with the *Lift* – they're not doing it right! You obviously can't unload a cam that is under full bodyweight or even partial bodyweight, it wouldn't be much of an ascender if that was possible but there are degrees of 'unloading' and with some devices, especially toothed cams, downclimbing can be a pain. The *Lift* engages so well that you need to virtually de-weight completely before it can move but it is then much smoother than a toothed cam. As an ascender it is excellent on dry ropes but as with all of the pivoting devices you lose a few inches of progress when the *Lift* transitions to being loaded. We haven't had any problems on wet ropes and while it's hard to see how such a smooth interface would fare well with iced ropes it seems to have no problem. In this age of global warming and unlike colleagues in the US, we didn't get enough cold weather to test this properly. We soaked an 9mm rope overnight then deep froze it for a week before bouncing a not inconsiderable bodyweight on it (pic right) and that didn't phase the *Lift*'s operation at all. Interestingly we used the smaller diameter thinking it would be a harder test on frozen rope but on reflection, perhaps a bulkier 11mm would have been a more difficult test? Either way, it worked for us but we remain a bit wary of using it on larger frozen ropes. Talking of larger diameters, on 13mm/ 1/2" rope which is the Lift's upper limit, operation becomes slightly more 'jerky' as you would expect but still surprisingly easy and functional.

We like CAMP gear, we were using their *RockStar* helmets and *BetClimb* carabiners for climbing 30 year ago so you can't say they don't have longevity and we're never sure why they're not a much bigger force in rescue outside of central/southern Europe. They deserve to be. The *Lift* is one of their less sophisticated though deceptively capable products. Size and weight, or lack of it, is the key to the attraction of the Lift but it's also a drawback because it is ONLY a personal or single-person device so as long as you remember that, it's a handy item to have on your rack.

ROYAL NATIONAL LIFEBOAT INSTITUTE (RNLI)

OFFSHORE RESCUE BOAT CREW- UK

TEAM MEMBER – CHRIS WALKER

(Currently full-time Cox London Lifeboat, Thames)

Lined storm collar with high-viz hood

Crewsaver ALB290 Twin-chambered 290N LifeJacket
Integral whistle and auto-activated flashing beacon, attachment D-ring, 2 accessories pockets, padded collar, heavy duty YKK centre zip

Gecko Mk11 Helmet
As of 2018 about 100 stations have helmet-mounted GoPro cameras on 3-D printed mountings for use in ongoing BBC documentary series on the RNLI.

Reflective panels

Accessory pouch on left – Casualty Care medical check cards, Sharpie pen and safety goggles
Accessory pouch on right – can contain cowstail lanyard and personal items like chem-lights, torch etc.

Crewsaver Marine Safety Cowstail Lanyard
For use on casualty vessels and on safety rails of offshore lifeboats. Store in ALB290 pouches

Inflation tube for internal padding gives customised, firm fit.

Life Jacket Leg loops

Helly Hansen multi layer technical layer system with breathable, wicking base-layer salopettes and separate jacket. Trousers have one accessory pocket and one mesh accessory pocket.

Black areas are reinforced panels plus
Reinforced hem on trouser bottoms

Boots – stainless steel penetration resistant sole plus toe protection

Pic by Simon Moss

RNLI Offshore Boat Crew

Pic by Nigel Millard

RNLI introduce new Offshore suits

Our thanks to RNLI's excellent in-house magazine for the following insight into choosing their new offshore suit:
1990 [was] the last time the RNLI introduced a new all-weather lifeboat crew kit. Now, after almost three decades, three iterations, and thousands of lives saved, it's time for an upgrade. 'I spend my working life keeping our crews safe,' says Allen Stevens. Senior Engineer at RNLI Headquarters in Poole, Dorset, he's one of those responsible for introducing the new offshore gear. 'Our all-weather lifeboat crews operate in every condition,' he continues. 'In Shetland, they're nearer to Norway than London. By comparison, south coast England weather is relatively mild. We have a duty to give our volunteers the right kit, wherever they are.'

WHY CHANGE IT NOW?

'The outgoing kit was quite high tech for its day,' says Allen. 'It's done the job. But when it was introduced, material technologies were in their infancy. Nowadays people we rescue are wearing better gear than we are! 'We want to lead by example – everyone should be correctly dressed for the conditions they're intending to sail in.'

We needed to find the best partner to work with on the new kit. We started with 20 companies and began a tough selection process – with the help of lifeboat crew. 'To kick things off, we invited all the companies to a presentation in Poole,' explains RNLI Principal Procurement Manager Matt Keatley. 'We challenged the marine clothing industry to provide a solution to meet the demanding and varied needs of the RNLI and the different geographical environments we operate in. Crew members were on hand to answer their questions. 'Afterwards, we whittled it down to eight companies to be invited to tender for the replacement kit. They then brought their gear, and pitched to a panel of RNLI crews and commercial teams. Our crews tried that kit on – even rolled around the floor in it! We picked two for trials.'

'The two trial kits were anonymous,' says Matt. 'There was no branding tying them to any manufacturer. 'We sent them to six all-weather lifeboat stations: Tenby, Weymouth, Lochinver, Hoylake, Dun Laoghaire and Humber – high-use stations, spread all over the UK and Ireland, capturing the different conditions the kit would operate in. 'Testing involved everything from helicopter lifts to slipway launches, crew recovery, boat-to-boat … you name it, we did it. 'We also trialled the kit across male and female crews, including female-only gear. 'The trials lasted over 6 months. Crews completed over 500 feedback forms, telling us how the kit performed; feel; sizing. The manufacturers took that feedback, and sent us revised versions, which crews tested and scored too. We used that, along with two final presentations, to pick the final kit from Helly Hansen. 'It was a thorough process,' concludes Matt. 'It all had to be done fairly, and we had to get it right. We owe it to our supporters to spend their money wisely. And we owe our volunteers the best kit possible for the next 10 years or more.'

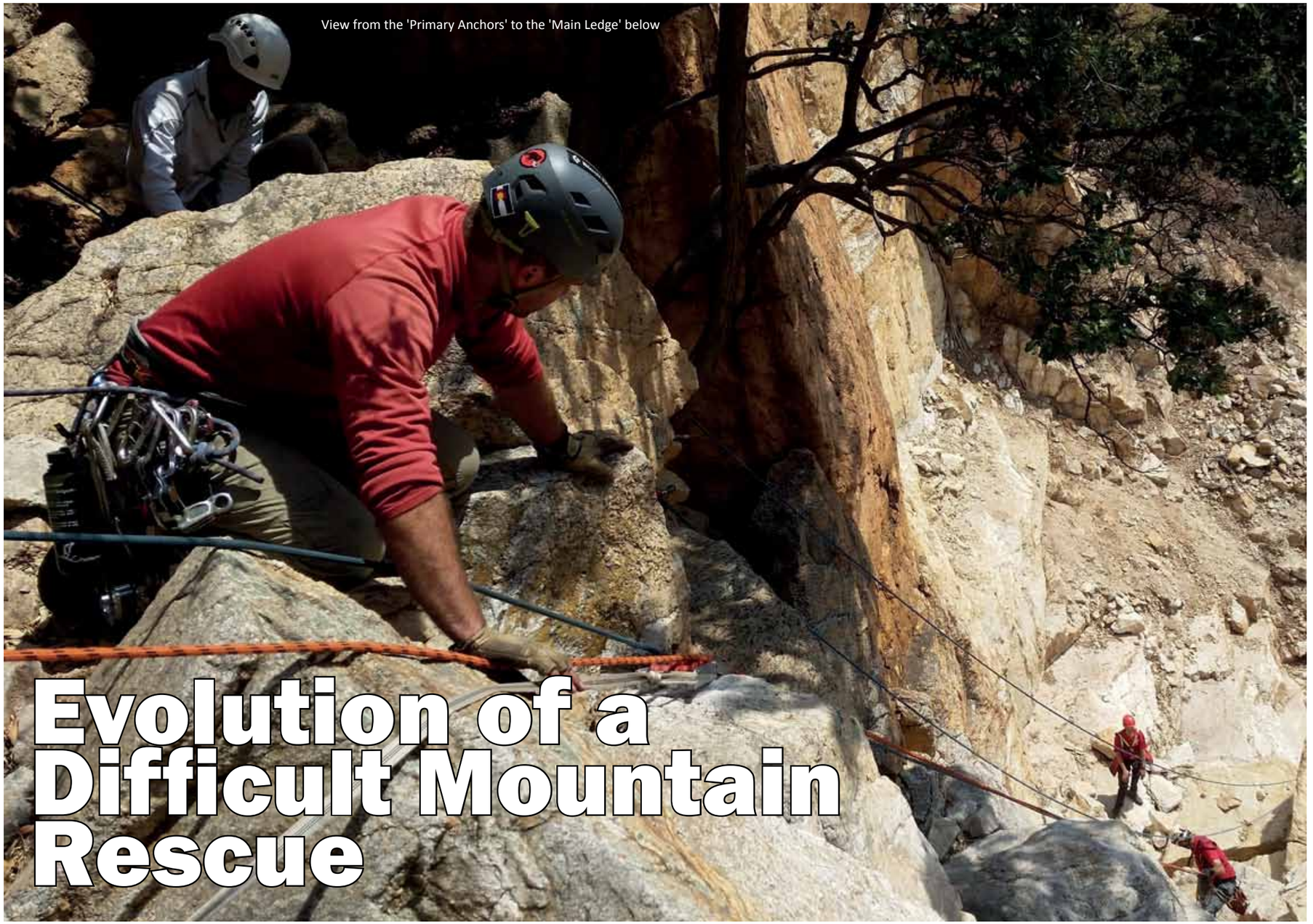
'Our new kit is a system,' says Allen Stevens, 'like you'd find in modern hiking gear. Our crews will wear a base layer next to the skin, a middle layer, and a breathable top layer. Each layer works with the next; passing perspiration through, but keeping wind and water out. In warmer weather, our crews can regulate their temperature by choosing their layers. 'It's also important the new kit doesn't interfere with the helmets or the lifejackets. The safety of our volunteers is an absolute priority while they are out saving people. 'It's all off-the-shelf gear Helly Hansen has modified for the RNLI. So the good news for our supporters is they could walk into a shop and get something similar.'

Breathable, Female drop-seat and contoured inner layers, 2 leg lengths so no more dragging and wearing of hem, replaceable elastic shoulder straps, reflective panels 'Breathability is my new favourite word,' adds Alice. 'I think it'll be revolutionary. Returning from a shout not drenched in sweat – it's pretty nice!'

And it's not just great kit that Helly Hansen is providing us with. The RNLI and Helly Hansen are entering into a full strategic partnership that will see Helly Hansen committing to deliver drowning prevention messages to their customers worldwide, in addition to supporting our fundraising and safety campaigns.
website: RNLI.org/magazine

www.rescuemagazines.com

MISSION REPORT



Evolution of a Difficult Mountain Rescue

as reported by the Media

by Rob Thomas
MCSA Search & Rescue Team – South Africa

2014-09-20 19:59

Johannesburg – Rescue operations are under way in Rustenburg to free a man who is trapped on the Magaliesburg mountains, rescuers said on Saturday.

"The man fell down into a gap between two boulders," Mountain Club of SA Search and Rescue spokesperson Dean van der Merwe said.

"It appears that while the man was falling, there was also a

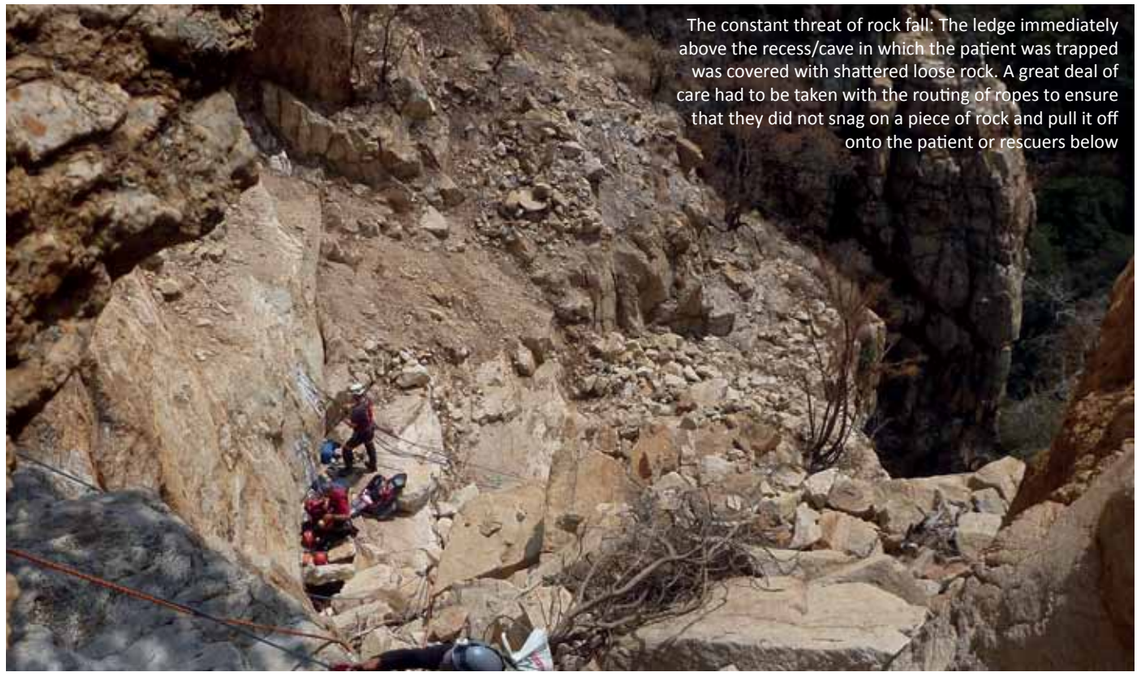
Above: View from the Helo. Below: A SAPS Air Wing Helicopter helped to ferry rescuers, who were working around the clock in shifts, up and down the mountain. In this pic the heli is being used to point out the location of the patient.

www.rescuemagazines.com

MISSION REPORT

BELOW: The constant threat of rock fall: The roof of the recess above the rescuers and the patient is just a pile of loose rock that was threatening to come tumbling down.

BELOW: The constant threat of rock fall: The roof of the recess above the rescuers and the patient is just a pile of loose rock that was threatening to come tumbling down.



The constant threat of rock fall: The ledge immediately above the recess/cave in which the patient was trapped was covered with shattered loose rock. A great deal of care had to be taken with the routing of ropes to ensure that they did not snag on a piece of rock and pull it off onto the patient or rescuers below

rock-fall at the same time causing his leg to be trapped."

North West police spokesperson Pelonomi Makau said it was believed the man went up on the mountain on Friday.

While he was on top, he is said to have seen a snake. He then jumped and that was when he fell in between the boulders.

Rescue operations started on Friday evening but emergency personnel could only reach the injured man on Saturday, said Van der Merwe.

"The rescue team tried to access the man from 20:00 on Friday, but the search was called off around 03:00 on Saturday. It was started again at first light and we were able to spot him around 07:00," said Van der Merwe.

He said rescuers were unable to move the rock in between the boulders and added that the terrain was making it very difficult for rescuers to get him out.

"Once freed, we will have to put him on a stretcher and haul him to safety before transporting him to a hospital," he said.

Van der Merwe said the police's air wing had supplied a helicopter to assist in transporting people up and down the mountain.

The SA National Defence Force was also on standby to assist.

He said more teams were being called in to relieve the team that had been on the mountain for more than 24 hours.

Man Loses Leg In Daring Mountain Rescue

A 26-year-old North West man spent about 48 hours trapped between two boulders after he fell at the Magaliesburg Mountains on Friday. According to Mountain Club of SA (MCSA) Search and Rescue team leader Rob Thomas, about 100 people and many organisations were involved in the man's rescue which culminated in the amputation of his right leg.

"The crack was only 18cm wide, he was trapped at the ankle. We were literally working upside down. It was very difficult to work," said Thomas.

MCSA Search and Rescue spokesperson Dean van der Merwe, said the man, Tsenolo Shadrack Rasello, fell after jumping away from a snake. He notified his family who contacted authorities.

Thomas said Rasello spent the Friday night alone on the mountain because the rescue team could not locate him in the dark.

"There was no way we were going to find him in the dark. The team decided to stop," he said.

"When daylight came we realised that the chances of finding him were slim. The police helicopter team came and pointed out his location to us. We set up an abseil, but the rocks there were very loose. A recent rockfall had happened there.

"To get to the patient was a 40m abseil, I went down and tried to get his foot out, but all the techniques we tried were not working.

After being freed from where the man was trapped, he was placed in a stretcher and hauled up the side of the mountain to a suitable ledge from which he could be hoisted into a helicopter. This photo shows a Mountain Club of SA rescuer manoeuvring the stretcher down the cliff face loaded with equipment to be used in the rescue.

Thomas said various organisations got involved including Rustenburg Fire Service, North West Disaster Management, Offroad Rescue Unit, SA Air Force, Rescue SA, Lonmin mine rescue, Impala mine rescue, Netcare, ER24, and Medi-Assist. After trying various methods, including baby oil and chipping away at the rock, the rescue team decided to amputate Rasello's leg on Saturday night.

"We connected them [the surgeons] to ropes and lowered them down, while we controlled the ropes from the top. A stretcher was (lowered) to get him on to do the amputation," said Thomas.

"There were lots of complications, rock falls could have happened. They worked in very difficult circumstances."

Rasello was transported to Chris Hani-Baragwanath Hospital in Soweto after the amputation.

BELOW LEFT: A SAAF BK177 helicopter that was participating in the bi-annual AAD air show assisted in transferring rescuers and medical personnel on the final day of the rescue and ultimately hoisted the man and transported to the top of the mountain from where a medical helicopter transferred him to hospital.

BELOW: The constant threat of rock fall: This loose pie of broken rock was immediately above the patient's head.

STERLING

PRODUCT TESTING IS IN OUR BLOOD.

It's why Sterling products consistently exceed certification standards and are trusted in harsh, real-world rescue situations.

Working with expert field testers, including independent tester Mike Forbes of RopeCraft.org, who designs torture tests for life-safety gear, provides us with unbiased feedback and objective results. This allows us to improve our processes, develop new products like the SafeGuard™ Rope Protector, and redesign existing favorites like the SuperStatic2 Series.

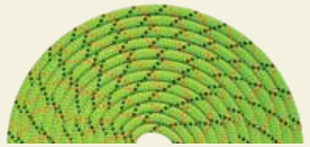
Visit SterlingRope.com for more details on our testing procedures, certifications and product lines.

Joe Klementovich

NEW SafeGuard™ Rope Protector

Length: 18"

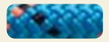
The SafeGuard is designed to protect ropes on sharp, jagged edges or over especially rough surfaces. It allows ropes to move freely while avoiding abrasion or cutting damage and has been thoroughly tested in industrial and outdoor rescue setups.



Green

Red

White



Blue

Black

NEW 11 mm (7/16") WorkPro™

Our low-elongation, dual-certified, static rope is light, easy to work with, and significantly stronger than other similarly constructed ropes. With a pre-steamed nylon core and 32-carrier polyester sheath, the WorkPro gets its strength from the balanced core and sheath that share loads evenly.

EN 1891: Type A & NFPA 1983: Technical

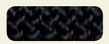
MBS: 8,092 lb

Orange

Red

White

Blue



Black

Yellow

11 mm (7/16") SuperStatic2™

Our do-it-all static rope is 100% nylon, with a core specifically engineered for more flexibility and better handling. The SuperStatic2 is compatible with a broad range of gear and hardware, making it the ideal rope for all types of high-angle rescue scenarios.

NFPA 1983: Technical

MBS: 6,519 lb

BESTARD

Search&Rescue Pro Boot

by Roland Curll

NSW Police Rescue – Australia

Roland is a 19 year veteran of Police Rescue in NSW Australia responsible for rope rescue, extrication, SAR, trauma and swiftwater rescue in the Ilawarra region south of Sydney. This huge region incorporates significant coastal cliffs and the Upper Nepean river basin with remote bush, forest, canyons and waterways.

Canyoning (or canyoneering) is an outdoor activity that can take you into some pretty remote areas. The 'wet canyons' are the most popular due to the excitement of being able to rappel down a waterfall. Getting from one end of the canyon to the other can muster a large combination of disciplines, such as rappelling, scrambling, hiking, and water skills. Needing to be competent in a whole range of skills to be able to negotiate such challenges can sometimes result in an accident. Some canyonning trips can take several hours to negotiate, or even days. However, if something goes wrong it can then become a big challenge for a rescue team to access and rescue the patient.

The common footwear choice for recreational canyonning is to wear a pair of old sneakers. Another choice is to wear a pair of sport sandals like the ones made by Teva. But does a rescue team need something better suited for responding to a rescue in a canyon?
Along with the wet rocks, the waterfalls, the steep terrain, and the remote area, there is also the challenge of carrying extra equipment for conducting a rescue and for manoeuvring a patient over a long distance.

Bestard initially designed the "Canyon Guide Boot" which had some great reviews and is now one of the most popular choices when it comes to selecting canyonning footwear. Based on that design Bestard has recently released another boot. This time it's the Bestard "Search and Rescue Pro Boot", which is similar to the Canyon Guide Boot but with input from one of R3's water rescue instructors, has a few features that make it standout for rescue teams. Such features include a reinforced toe cap, stainless steel lace eyelets for operating in areas with salt water, and an anti-perforation innersole to avoid injury when stepping on sharp rocks or other objects which could perforate the bottom of the boot.

The upper material of the boot is mostly black, styling a large section of the boot in yellow helping it to stand-out, along with the reflective strips for high visibility.

ORIGIN:	SPAIN
COST:	£125 / $173 / €153
WEIGHT:	1200g (pr EU43/UK 9ish/ US 10ish)
MATERIALS:	Cordura uppers with..... Microtech H2O / Rubber Pro Hidro–Mesh lining Bestflex 2 /Flexible midsole Removable anatomical insole Removable non perforated insole 'Canyon' last.
SOLE:	Vibram Best Idro-grip + EVA
SIZING:	UK 4-13 / US 5-14 / EU 37-48.5
WEB:	www.bestard.com

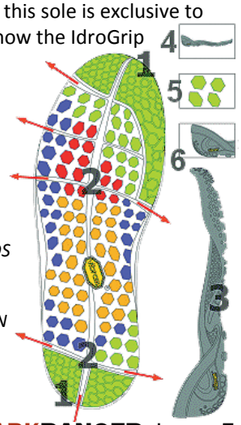
Still in use at the time of writing, we first tested this boot in the Blue Mountains of NSW, Australia at a place called Claustral Canyon. Access to the canyon involved some hiking to get to the entrance of the canyon, and once the canyon negotiation was completed it involved further hiking to get back out. The challenge in this instance for this boot was to be able to perform in rough terrain out of the water as well as meet the challenges in the water.

It is a very common recommendation that boots should be broken-in properly, initially to help prevent problems in the field. These boots had not been broken-in prior to testing them in the field which sounds like a big mistake, especially seeing as the trip involved wearing the boots for eight hours straight. The Bestard Search and Rescue Pro Boots were actually comfortable enough that it didn't matter.

At first glance they appear similar to a pair of mountaineering boots, which is understandable because the maker, Bestard, is a Spanish company in Majorca that specialises in mountaineering and activity footwear. This boot is actually lighter and not as bulky as they first appear to be.
The boot laces allow for a lot of adjustment and increased ankle support as needed. The eyelets halfway up the boots enable the laces to lock in place so that the lower part of the lacing can be tensioned differently to the upper part, such as having the lower lacing tight and the upper lacing loose. This lacing system offers a lot more comfort compared to other canyon boots. Once the laces are tied, the knot and the ends of the laces can then be tucked into a small pouch located at the front of the tongue. This prevented the laces catching or hooking onto shrubbery.

The hike into the canyon involved negotiating steep terrain down to the canyon and as we got closer to where the actual canyoning began we found ourselves walking on wet slippery rocks. The boots Vibram Hydro soles performed at an exceptional level. Using Vibram's IdroGrip, the soles are designed to give excellent grip whether the surface is wet or dry. The toes of the sole have a flatter grip pattern compared to the rest of the sole to provide extra grip yet ridged enough for edging with the boot. This is also the same for the heel part and near the instep. Bestard say that this sole is exclusive to them and this is their description of how the IdroGrip functions:

1) Large contact area for GRIP ON ROCK
2) Water draining channel to enhance grip in the wet (red arrows)
3) Vibram® IDROGRIP compound to improve rip in the wet
4) High profile cupsole for FOOT PROTECTION ON UNSTABLE RIVER BEDS
5) Multiple hexagonal lugs for SENSITIVENESS and GRIP
6) High profile heel for FOOT PROTECTION WHEN JUMPING INTO WATER



There is a drawstring type closure at the top of the boots, referred to as ‘gravel gators’ designed to prevent bits of debris from getting inside the boots minimising the need to stop every few minutes to empty out what your boot had collected along the way.

Once in the ‘wet’ part of the canyon the boots were able to grip just as effectively after being submerged as well as when dry. When swimming through the water the boots were actually more buoyant than you would first presume them to be, and each side of the boot is designed with two drain holes to help expel water. Parts of the canyon involved rappelling down waterfalls, together with climbing down on wet rocks. The Search and Rescue Pro Boots not only gripped well but they were also a comfortable fit.

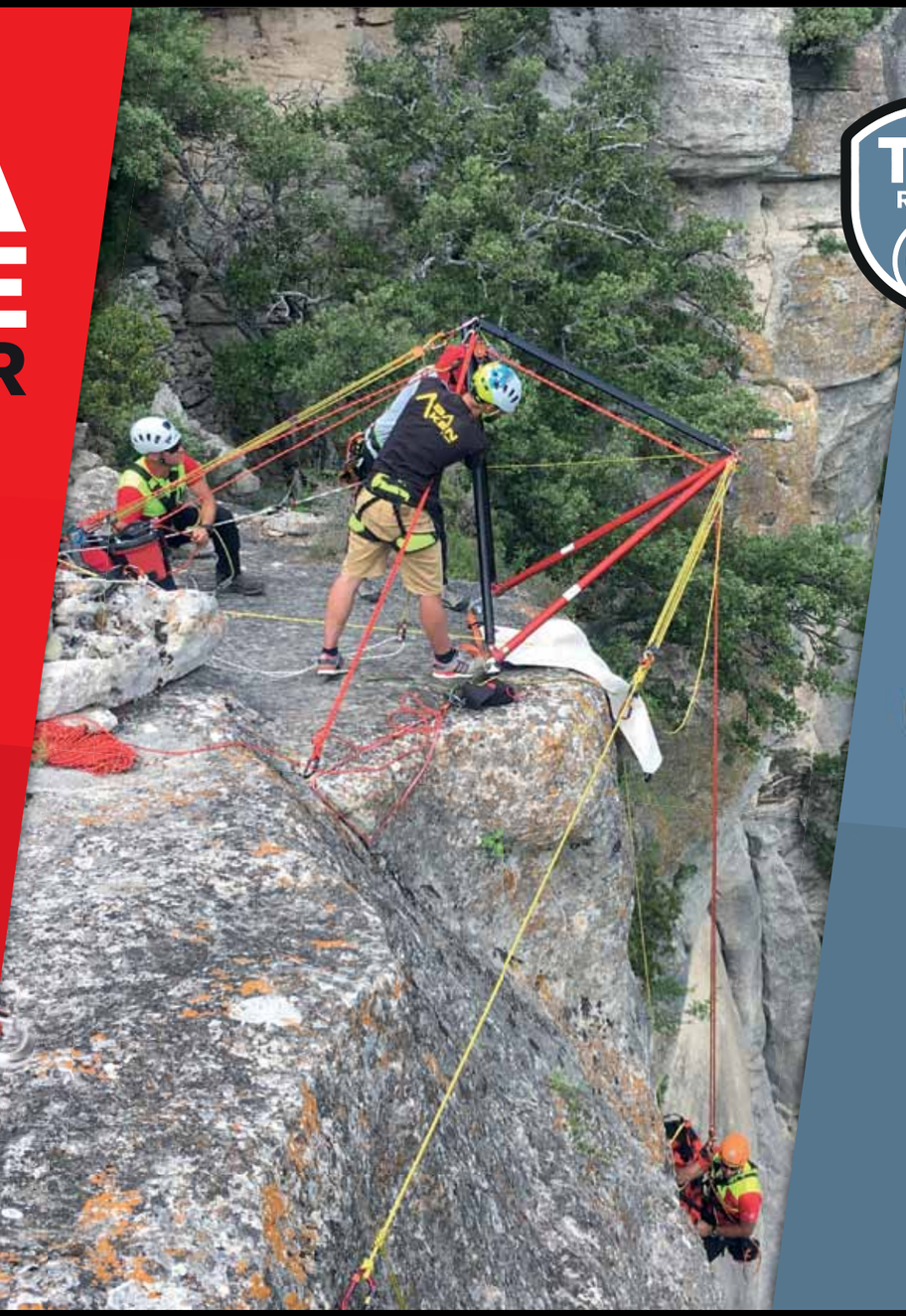
Once out of the canyon there was a lot of trekking required to get back out to civilisation. This involved a lot of hiking up steep hills, and some rock scrambling. It was fortunate that the Search and Rescue Pro Boots work in both environments, performing at a high standard throughout the testing. Having been through some rough treatment in the canyon, other than being wet and dirty, they maintained their integrity and did not require any repairing or component replacing at all.

The “Search and Rescue Pro Canyon Boots” are well made with quality materials, and they are just as tough as they are light. The boot is designed by people who know how to make boots of an exceptionally high standard, and these manufacturers understand the specific needs that are required in canyons' water rescue scenarios and have also tested them in such conditions. From a Search and Rescue point of view, not having to worry about slipping over all the time, worrying about your feet being uncomfortable, or worrying about your boots falling apart in the middle of an operation is a real ‘load-off-the-mind’ and allows more concentration on the task at hand.
The ability for these boots to perform in both wet and dry environments makes them a versatile pair of boots. They are primarily designed to be used in canyons and as such perform exceptionally in similar, arduous environments like caves, swiftwater and in flooded streets. This could also include being used for mud rescues.

The Bestard Search and Rescue Pro Canyon Boot fulfils the requirements of teams operating in any of the canyon-like environments, especially where they involve water. They are well built, light, sturdy and versatile. The benefits already mentioned show that these boots should be considered by any rescue team likely to perform a rescue in a canyoning location.

ULTRA PORTABLE LIFTING POWER

The PMX provides the strength and versatility of engine power in a highly-portable design that is built to endure the toughest environments.



FASTER RESCUES BATTERY POWER

IP68

Battery-powered, yet with a high lifting capacity, the TCX Rescue is incredibly fast to set up and boasts unrivalled rope climbing speed.

HAND-BUILT IN SWEDEN

ISO 9001 BUREAU VERITAS Certification

ActSafe Power Ascenders are an ingenious combination of a high capacity rope winch in a compact, lightweight and user-friendly design. They simply redefine the possibilities for working in vertical environments.

Get in touch with us today to find your nearest ActSafe distributor

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Sagbäcksvägen 13
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E: info@actsafe.se
W: www.actsafe.se

ActSafe™

TEAM WENDY M-216 Ski-SAR HELMET

Website: www.teamwendy.com

Cost: approx US$350

FEATURES

- Removable ear covers.
- Interior in-ear communication/ audio pockets.
- 14 vents inc. 8 adjustable crown vents with 3 positions, 2 passive open front and 4 fixed open rear.
- Fidlock magnetic buckle for
- one-handed operation.
- Accessory rails for mounting lights, cameras, etc.
- BOA Fit system for precise adjustment with single handed quick release.
- Glass-reinforced polycarbonate shroud for mounting NOD's, cameras and head lamps.
- Included Princeton TEC Light; your choice of Switch Rail or MPLS.
- Colors: black/grey , Red/grey, white/ grey, grey Camo.
- Sizes: Small to x-large.
- Integrated goggle strap retention
- Lightweight EPS impact liner with a removable and washable comfort liner.
- Meets the impact attenuation re- quirements of both ASTM F-2040 and EN1077 Class B
- ABS polymer hard front shell; rein- forced accessory mounting areas while minimizing weight.

INTRODUCTION

It's convenient to make equipment quality comparisons based on cars. Helmets are like cars in that they will pretty much *all* do the basic job of getting you from point A to point B in relative safety and relative comfort. An entry level imported helmet with polypropylene, single skin and a web cradle or polystyrene insert is your entry level Ford or Chrysler Neon. It meets the basic standards and it's eminently affordable. Next you have the entry level helmets from recognised manufacturers like Edelrid, Kong, CAMP, Black Diamond etc. These are the mass-usage helmets, whether used by teams or recreational users and are akin to Honda, mid-range Fords or any Volkswagen in car terms. Then there are the mass-pro usage, higher cost helmets – the Petzls, Gallets and Kask together with top of their range Kongs or Edelrids etc. These are the Audis, Lexus and Mercedes. Then there are the Aston Martins and Bentleys. In the rescue world there are very few in this category because they're just too expensive, in fact, if you take out Firefighting helmets you're really only left with the Pfanner Protos and this one, the Team Wendy M-216 and for pure ski Search and Rescue-use, guess which one is the luxurious, high performing Aston Martin. You can't get beyond cost as a major barrier to most users but equally that doesn't stop the M-216 being the helmet that you would aspire to if money were no object.

Team Wendy are probably best known as a military helmet manufacturer with their iconic Exfil models that have been in more Hollywood/Netflix productions than Arnie. But they actually originate with the Ski market. Their entire raison d'être was as a result of the untimely death of boss Dan Moore's daughter Wendy in a skiing accident resulting in traumatic Brain Injury. Still unfortunately all too familiar ala Michael Schumacher. Having set up the company on a mission to improve safety for skiers they were perhaps a little too successful and attracted the attention of the Military, not as a target for a drone attack but as a whole world of customers for a modification of their ski helmet that included the same comfort levels using what they call multi-impact foam or Zorbeum. Sounds made up to us but the military like strange words with 'Z' in them and it seems that comfort not ballistic protection was the game-changer since anybody could produce a bullet-proof helmet, I could beat one out of a sheet of metal but it wouldn't be very comfortable. So Team Wendy spent several years in the Military world perfecting and upgrading their basic designs until last year they finally went full circle and brought out what they hoped would be the pinnacle of professional ski helmets.

TESTING and STANDARDS

It's not just that they have a neat design that works well as a mountain/ ski helmet, they seem to have really tried to back this up with research on the science of impact protection. I can count on one hand, in fact half of one hand, the number of companies that produce helmets AND give you detailed information or a trail to follow regarding their protection claims. We take it for granted that a helmet that glibly states that it is CE marked or adheres to an ASTM is good enough for our needs. But there are two flaws in that theory. Firstly, helmets that are simply badged or rebadged by a recognised company are not made or tested by the name we think we trust. How do we know they actually ARE capable of withstanding the required impact forces for our particular discipline? And secondly, how do we know that the standard is actually fit for purpose? That big CE symbol might mean it meets the standard for a salad mixing bowl for all you know. That's why we like to see companies like Petzl and Team Wendy fully explaining the safety aspects of their helmets. Team Wendy seem to have particular drive in this regard and stated recently that they're part of a tri-institution (Brown University in Rhode Island, Drexel University in Philadelphia, and Sandia National Laboratory based in New Mexico) research project funded by a grant of $4.75 million from the Office of Naval Research to look into traumatic brain injury and (presumably) how it can be best protected by helmet design. Excellent, but that begs the question, if that's research for future helmets, how good are all the current helmets?

There are of course plenty of confusing standards to do your homework on. This M-216 for instance, meets ASTM F2040-11 which is recreational snow sports including skiing and EN1077:2007 Class B which is a European standard covering skiing and snowboarding with top impact resistance less than and covering a smaller area than that of a Class A helmet though ventilation and comfort tend to be better. **The M-216 does NOT meet the European standard EN12492 covering climbing with resistance to lateral impact as well as impact from above so the M-216 should <u>NOT</u> be used as a climbing/vertical rope-work helmet.** What a shame – it turns out that the M-216 is not quite the universal rescue helmet we were hoping, or indeed as the Exfil SAR is. The M-216 is quite specifically a SKI-PATROL and SEARCH helmet. As long as you remember that and don't wander too much into the vertical realm this might still be the helmet you strive for. If we go back to the car analogy, would you let your mate borrow your Aston Martin to pick up a lawn mower he's just bought

This is why you'll buy it.....

←This is how you'll actually use it....

probably not even with this expensive a headlamp!

There are government agency teams and well-funded civil teams, generally resort financed, that can afford all the IR, and TI NVGs and that snazzy beacon on the top which is also shown on our front cover not to mention GoPro cameras or the much tougher and well-suited MOHOC cameras but generally-speaking, if you or your team has laid out the cash for the M-216 you've probably only got enough money left for an AA battery headlamp. The M-216 rear elastic retention strap shown below, is intended for goggles of course but it will handle both headlamp and goggle strap simultaneously. It has a kind of plastic 'handle' so that you can more easily unhook the elastic while wearing gloves and being able to use this helmets with gloves is mandatory as a Ski-SAR helmet. In the picture above the headlamp is sat snugly within the Shroud insert (left) but this is actually intended to take proprietary mounts for cameras, NVG etc.

on Ebay, no, you'd let him use your old Land Rover, it'll do just as good a job, it just won't be as comfortable.

SHELL

Helmet construction is quite interesting on the M-216 – TW describe it as light 'Hybrid' because the front two thirds of the outer shell is an ABS polymer that feels similar to other quality helmets but it sits on a completely different polycarbonate inner shell which you can see in this picture as the dark grey section on the bottom. This grey polycarbonate provides about a third of the outer shell at the rear but then dives under the white ABS shell to form the entire inner frame for the expanded Polystyrene liner. Unlike the flexible inner cradle that we're used to in climbing helmets, the M-216 has almost an inch of hard polycarbonate to space your head from the outer shell.

You can see this more clearly in the pics above.

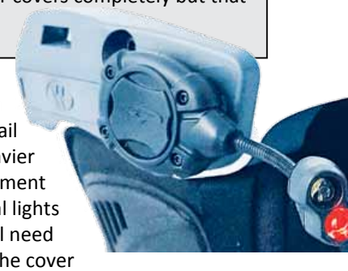
One of Team Wendy's most popular features in their military helmets is the vast array of effective removable comfort liners and padding (not to be confused with the EPS liner we've just mentioned). The M-216 also benefits from this with a strategically padded and meshed complete inner liner which is easily detached with some very slick mini-Velcro looking bits that aren't actually Velcro. The liner can therefore be easily removed and washed or replaced. This is noticeably more comfortable than the majority of helmets we use though the *Pfanner Protos Integral* does offer something similar. Incidentally the *Protos* weighs 863g while the M-216 weighs only 610g on the Large model so that hybrid shell does offer quite a large weight-saving. For comparison, a Petzl Vertex weighs 455g. Before we leave the outer shell structure, you can see the vents in the picture far left. The 8 vents on the top of the shell have three positions – Open, Closed and Half-Open. All easily achieved with a gloved hand by pushing that central grey (knurled) button you can see into two firmly clicked positions. The rear part of the white shell provides a handy lip to pull against. Air flow is really good with the M-216 because, aside from the liner mesh, the shell has rear facing vents that are always open. These act like exhaust vents if you pump your helmet up and down on your head – which is weird – don't do it.

Finally on the 'cradle' part of the structure, there is an adjustment system that TW call 'Boa'. We're quite used to this style of ratchet system as it's been standard on fire and rescue helmets for decades but it's noticeable how nicely engineered this version is. The button pops in to allow you to twirl it to increase or decrease the head band circumference and you pop it back out to lock. The button-mount has an odd indent hanging below the button which I found to be a pain in the neck, literally.

I don't have a fat neck, at least I didn't think so and made sure the helmet was properly oriented on my head but still, a treetop search for 20 minutes was enough to force me to adjust the helmet further forward than it should be. Perhaps I need to put my fat neck on a diet? It's quite a solid component though and could have a more rounded profile or even be reduced in size? If this was an Aston Martin it would have an elegant curve and a walnut veneer, no wait, solid walnut.

MILITARY CROSS-POLLINATION

Team Wendy's military sojourn taught them that rails is the way to go because there are and there will continue to be, a huge array of equipment being produced for the military that is equally useful to rescuers. The rail and Picatinny system provides an absolutely secure anchorage on the helmet for lighting and imaging equipment that is otherwise pretty heavy. So heavy in fact that you can purchase counterweights to balance the helmet if you can't afford a second piece of heavy imaging equipment to balance the other side. The M-216 comes with accessory rail mounts which will take the Princeton Tec Task lights as a push-in using the round and curved openings in the grey rail you can see in the picture above left.



To attach a Picatinny rail for the heavier NVG equipment and tactical lights etc you will need to pry off the cover plate (with the Wendy logo). This is easily popped out with any small screwdriver. The PTec Switch LED deserves special mention because it's a $70 component that comes with your helmet. Ours had a white and a red LED but there is also a triple bank LED option in the flexible stem version. The single while LED offers 10 lumen of light – not massive, enough to illuminate your map or hands while you attend to a task. The PTec Switch is brilliant, the flexible stalk allows you to point where you like or stow it out of your eye line but we did see some people moaning so there's also this version without the stalk.

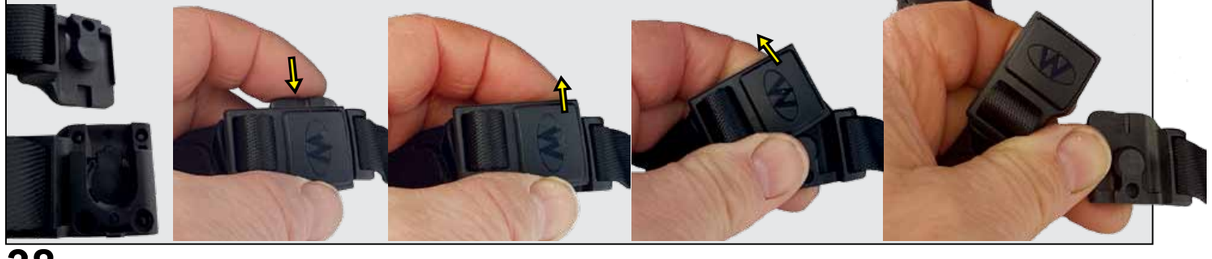
The M-216 is *THE* helmet for Ski Patrol, and mountain search teams (though not climbing rescuers) and will be the benchmark by which other rescue helmets are judged for some time to come.

EAR COVERS

Perhaps *THE* key reason you would buy the M-216 Ski-SAR are the sumptuous ear guards/flap otherwise you would just buy the Exfil SAR? As you can see from the cover shot and the Contents page, a balaclava is usually worn (and can be supplied by Team Wendy) but we chose to have a naked head because our UK winter was not as much of a challenge as it might usually be and is never as challenging as our Scandinavian and Candian/US colleagues. Nevertheless, we did get some biting winds to bring -5 to -10 degrees down to around -20 and our ears thanked us for the M-216. There was no comparison between this and a regular, cutaway helmet in terms of comfort and warmth. However, for warmth, though not so much comfort, we noticed that our regular chainsaw helmet ear defenders did a similar job in a Chrysler Neon kind of way except you couldn't hear anything! M-216 has great audible acuity and you can open the internal ear padding to insert comms or even extra padding and/or a snap-warmer if it's that cold. You can remove the ear covers completely but that process wasn't as easy as the instructions made it sound.

CHIN STRAP & FIDLOCK BUCKLE

The M-216 uses Team Wendy's 'Fidlock' buckle on the chinstrap, a chin strap which is, as you would expect, fully adjustable and comfort-padded with a replaceable/washable wrap-around cover (pic right).
Fidlock is described by some as a magnetic closure but it's actually a keyhole style closure that does the securing and is helped along by magnets. In the picture below left you can see the two halves of the buckle, one of which has to be flipped over to properly face its opposite number. The magnets help the two halves to meet each other making it much easier to do one handed. You may very occasionally have to align the 'key' with the 'keyhole' before it will engage but 19 times out of 20 this works like a dream. Maybe some debris or sticky pine sap etc. gives rise to that one occasion you need assistance from your other hand or an understanding colleague who will probably say, 'hmm, haven't seen one of these before, how does it work?'....should have just done it yourself. Once engaged there is a protruding tab (first yellow arrow below)) that makes opening it just about the easiest on the market without the likelihood of coming undone at random times. It's an Aston Martin thing.



HEADLAMPS part 1

300+ lumen

Or, as we say in the UK, Headtorches but none of us should be saying 'Headlights' or the local store will be trying to sell you an overpriced lighting assembly for your car.
Due to the sheer number of headlamps on the market, and that's just in the better quality ranges, we've divided this GUIDE with over 150 models into three (maybe even four) parts based on the quoted Lumen output. Part 2 may be pushing it to cram so many into one issue so might end up being 2A & 2B!.

- **Part 1** Brightest models 300 lumen and above.
- **Part 2** Mid-size models 100 to 299 lumen
- **Part 3** Ultralight models 0 to99 lumen

The 300+ lumen models may be the brightest but that doesn't mean they're necessarily the best – they can be larger and heavier, overly complex and certainly more expensive. They might even be *too* bright for your needs though most have the ability to dial down the light output. Nevertheless, when reading this guide, bear in mind that you may find more relevant models in part 2 which is the mid-range models (and lots of them!) or you may be in the market for the smallest and lightest in part 3.

We're not entirely sure of the history of battery-powered headlamps but the first decent lightweight model we ever had was the Petzl Zoom in the early 80's. I think it arrived in 1981 and until then we had been using mining-style lamps from companies like Oldham and later Speleotechnics that were fantastically robust, long-lived and bright but weighed as much as that car headlight mentioned earlier. The Petzl Zoom can justifiably be regarded as an icon and led the market for a considerable number of years. Only Black Diamond seemed to cotton on to the potential market in the early days when the bulbs were all standard glass screw-ins with halogens for the more powerful options. Fast forward to the beginning of the new century and LED took over as king and Petzl no longer had the field unopposed though they weren't behind for long and are still a worthy market-leader having pioneered and kept pace with much of the electronic wizardry that now typifies headlamps. This was a long-winded Guide to compile because there are so many companies producing them. You could go onto Amazon and find literally hundreds and some of them look amazing. Take a look at this one from Outerdo, It's got those mean-looking multi-light heads giving out a whopping 5000 lumens, that's like having a tricked out truck on your head. It's got rechargeable batteries, weighs less than a hummingbird and costs less than a week's supply of hummingbird food ($14.).You could kit out the entire team to look like a Special Forces Dive team AND

still have enough left over for some dummy helmet mics to look like you're talking to each other. I wonder why this costs $14 when this other one (above) from LEDLENSER that also looks pretty cool and is also made in China only emits a paltry 2000 lumen and costs $275? You can even find headlamps with an eye-watering 30,000 lumen output (allegedly) costing only twenty or thirty dollars – how can this be? Too good to be true is how. Those enormous lumen output figures usually fail to mention that you'll only get that output for a few seconds at a time and where it will run for longer it will rapidly decrease to a more normal lumen output with far less noughts in it. One notable exception to the more dubious high-lumen output models is the Niterider ProMX model or two models in fact. We've included this purely because it can mount to a full-face helmet. It's intended for motocross but could easily have applications in rescue.

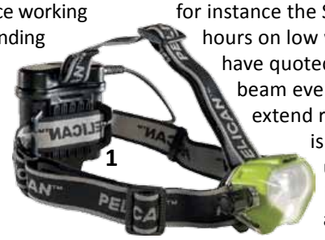
Regular readers will know that we subscribe to the old adage that you 'get-what-you-pay-for' Sometimes we might pay a bit more than we need to using the top-end companies but it will buy peace of mind at the very least. Our selection of headtorches is based ONLY on quality manufacturers, a couple of quality brands that outsource but actively target Rescue users and Nitecore and Olight from China as identifiable and good quality representatives of Chinese production, China having by far the largest proportion of world models. This doesn't mean that you can't buy a light from less tangible brands like 'Outerdo' and use it to good effect. In fact you could buy several of them for the same price as a LedLenser or a Petzl and treat them as disposable *BUT,* in the Emergency Services you want tried and tested reliability, a proven record under fire and accountability for the product. When that Outerdo or some other great-looking and incredibly cheap Walmart Special dies at a vital time, it won't feel like such a bargain. Some of you will swear by some obscure brand you bought several years ago or got free in a packet of breakfast cereal and there are indeed always exceptions to the 'get-what-you-pay-for' mantra but not often enough or consistently enough for us to worry about them here. You might buy one of the relatively expensive ones only to have that fail when you least want it to but at least you won't be blamed for skimping on quality in the first place, instead you can get the manufacturer to replace it, and with this selection, they'll all be pleased to do that because it's such a rare requirement.....won't you manufacturers!.... we can heartily recommend Koehler, Ledlenser, NiteRider, Petzl, Pelican, Princeton Tec, Silva, Streamlite, Surefire and Unilite because we have regularly used their products for decades. Brands we're not so familiar with but seem to be well respected are Ultimate Survival Technologies, Nitecore, Nightstick, Lux-Pro, Fenix, Coast, and Black Diamond of which, UST and BD have a broader product range than just lights so presumably outsource.
The future continues to point towards electronic sophistication although there is a lot to be said for the simplicity of an on-off switch giving you the choice of light or darkness. Petzl have been pioneering masters of technical electronics with their *Constant* lighting metering, *Reactive* lighting and programmable options. This is exemplified by the *Nao* although it's quite odd that *Petzl*'s most professionally capable model isn't listed under their 'Professional' range, only 'Sport'.

REGULATED OUTPUT: Petzl call it *Constant* lighting but it's the 'regulated' mode that many other brands now use and means that you get a regular light intensity for the full duration of the charge rather than a rapid or gradual drop-off of beam intensity once the batteries are low. This kind of electronic control circuitry also keeps an eye on temperature and should cells start to overheat it will regulate the light output to stop permanent damage. Regulated lights also monitor when it needs to go into reserve mode to save power and Boost or Turbo modes are limited for control of overheating.

REACTIVE LIGHTING is the opposite of 'Constant' and is of two types – Petzl's '*Reactive*' not to be confused with 'reactive' as a verb, uses a sensor to figure out the amount of reflected light and therefore the proximity of whatever you're looking at – if it's a map it turns down the lighting, if it's a way off in the distance it increases the power. The second version is a 'Face-to-Face' function which is much simpler than Petzl's '*Reactive*' but is reactive in the sense that it recognises proximity of other headlights and reacts by dimming your headlight accordingly – that will please your colleagues but is only any use to you if their headlamps are similarly equipped otherwise, prepare to be blinded if you're in a consultation huddle. Programmable lights means that you can read the complex instruction manual and then alter the set up of your light to suit your specific needs – you can change the range of brightness options, how it responds to low power, duration of functions etc. in Petzl's case, there's an app specifically for the *Nao* to further simplify controls and tell you exactly what battery use has been like and what's left in the tank- expect to see others using apps soon.

MATERIALS
The vast majority of these headlamps are made of some form of toughened plastic, not the thin brittle stuff that your kids' toy's battery enclosures are made of but tough enough to withstand a drop onto concrete from a metre/3ft up. That particular test is what sets the professional grade models in this guide apart from the cheaper camping lights. Machined and die-cast alloys are also evident in some brands like LEDLENSER and NITECORE. This always gives a reassuring feeling of being

robust even if some of the carbon-plastics are just as tough but they don't feature in any ATEX/intrinsic safety models. Talking of which, we have not included an ATEX/Intrinsic safety column because a hazardous atmosphere is not normally a risk that needs to be catered for in wilderness search and rescue. Nevertheless, many teams have responsibility for road accidents and remote industrial sites so intrinsic safety could be a useful feature. It tends to be on the lower power lights in part 2 of this guide because of close-quarter and confined space working which doesn't require a 1000 lumen spot light blinding everyone and everything in a 10 foot radius. Virtually all of these headlights conform to CE regulatory compliance and we have included ATEX/Intrinscially safe (IS) models in the notes.



HEAD BANDS

We didn't have room to include an indication of the type of headbands available. We barely had room for all the data as it is. However, this is a consideration. There are basically four broad types:

1) FULL strap with a lateral and dorsal strap, usually in a soft facing elasticated fabric. This retains the light well, especially on a helmet.

2) HEADBAND-only which will be in either a sweat-wicking elasticated band or it may be a much heavier duty solid black rubber.

3) INTERMEDIATE headband as exemplified by Fenix which has an occipital band coming off the lateral headband that helps keep the headlamp centred. There's also the Petzl Nao, minimalist version which is about as light as a headband can be and again hugs the occiput (rear brain-case).

IN THE FOLLOWING TABLES.....

MAX LUMEN as quoted by the manufacturers has become the industry standard measurement for light output in preference to Lux etc. so is the easiest way to compare like-for-like. Note that for some models, the quoted max lumen is for very short bursts only because the overheat protection would otherwise kick in. As an example, the Fenix HL32R can give you an hour's worth of 600 lumen but only in brief bursts so you could pretend to be a lighthouse but as a continual beam it's more accurately 300lm for 4.5hrs. Our problem here is that some max lumens that have crept into this guide like the Petzl Duo Z quoted at 430 lumen for a few seconds is more realistically 220 lumen for 2 hours- in which case it should be in Pt2 !

MIN RUN TIME is given for the main White light only and at its most powerful constant output setting (if this is variable). There are some models, that offer red, green and/or blue LEDs which will extend these times as will the emergency flashing modes but that is never at the max lumen.

MAX RUN TIME is at the minimum constant power output and this might not be using the main beam at all even if it's got variable output because many have additional, smaller 5mm LEDs. Some have high power LED, a low power LED and a coloured LED. In the case of the tactical helmet mounted lights for instance the Surefire HL, the white LED is quoted at 48 hours on low while the blue LED will give 120 hours – we have quoted the lowest power white LED on constant beam even though flashing (strobe) beams will also extend run time, considerably in most cases. There is a technical difference between what most users think is run time ie. from switching it on to the beam dying completely – it's a little better than that as Koehler nicely explain: "*Run Time is defined as the duration of time from the initial light output value – defined as 30 seconds after the point the device is first turned on – using fresh batteries, until the light output reaches 10% of the initial value.*"

FRONT LEDs.....

Indicates front beam colour options and a rough guide to LED size. This is obviously dictated by the colour of the LED but it can simply be a coloured lens over a white LED. Most LEDS are white with a clear lens and many have an additional, often smaller white or coloured LED to offer less dazzle and/or longer duration than the main beam alone. Some have a Red, green or blue LED to preserve night vision, some have all three colours and one model from Princeton Tec even has an infra red option if you're thinking of calling in an air strike. Pelican have some models with '*colour-correction*' output which casts a 'real' white light that doesn't artificially alter the colour of things like blood or change blues to green etc. Each separate LED gets its own square indicating colour of the front LED and relative size. Where interchangeable lens colour options are available (as distinct from on-board coloured LEDs) we've listed it in NOTES.

SPOT to FLOOD.....

refers to the width and/or strength of beam. This used to be altered with a twist of the bezel and in many cases still is but more often than not, variable or mixed beam output (shown as ■) is provided by the push of a button or might be automatic. Most will adjust between a tight spot giving intense light across a narrow beam to a more diffuse flood across a wide area and some combine the two types to create a mixed or vari beam. Close-in or proximity work uses either a flood mode or a dimmable LED to give less dazzle. Dimmable LED = the VARI symbol ■. Some, like the Streamlight Protac USB, use an add-on diffusion lens to alter a spot to a flood.

BEAM MODES.....
are unfortunately called by a wide variety of company-specific terms as they seek to stamp their own mark on industry nomenclature. So we've pretty much listed the modes as they do even though you'll spot many of the same modes under different names. Modes are changed by a range of mysterious push-button combinations, similar to a Freemason's handshake – nobody really knows what the sequences are, they just pretend that the ultimate beam mode is what they meant to do. Read instructions carefully and practice before you get into the field. Some, like the Surefire Maximus, have incremental beam adjustment from 1 lumen up to the full 1000 lumen so the number of 'Modes' is actually finite. With some intelligent systems the beam will automatically adjust for distance-from-object so that map reading uses a dimmer light than distance searching. Some lights have flashing or strobe modes that may be SOS signalling, rapid, epilepsy-inducing flashing or slow flashing. Emergency service vehicles discovered long ago that the most conspicuous lighting is a flashing white light so these will not only be more likely to attract attention it generally uses less energy as well. A number of the modes are designed to extend battery life by using a lower lumen output than the maximum and indeed some models only achieve the maximum quoted lumen output by pressing a 'boost' button for a few seconds at a time. The beam modes listed are for FRONT-LEDs only.

REAR LIGHT....
some models have a rear red or white LED – very useful for knowing the proximity of your colleague in the dark – that's if the enormous front-facing white light hadn't already given the game away. In actual fact, the rear light can be seen from over a kilometre away so there is method in the madness and these can be flashing or constant, flashing giving the longest battery life and shown ☐ for white flashing or ☐ for red flashing. An understandably popular feature for tactical users who are using a low visibility red or coloured beam and don't want to be shot in the back by colleagues.

BEAM THROW/DISTANCE....
is measured from the light to the point at which the lux reading is 0.25 which is roughly the same as a full moon on a clear night. **CANDELA** in burnt orange is the figure for beam intensity, generally at the centre of the beam and is the term that replaced 'candlepower' in the lighting industry.

ADJ HEAD ANGLE....
refers to the angle that the front headlamp can be manually adjusted to. Some will rotate 90 degrees to point directly at your feet while your face is still pointing forwards. This is generally achieved with an incremental 'ratchet' to keep the head firmly located in the desired direction. Some do not quote an angle so there may just be a black square.

BATTERIES included....
the type of battery being used with the burnt orange indicating what the model comes supplied with. Cells not supplied are shown in black but where a choice exists, the output data is based on the first battery type listed. Many will accept regular alkaline batteries as well as rechargeable or high-power lithium and/or Nickel Metal Hydride cells. Lithium cells like the smaller CR123 offer not only reduced bulk but resistance to low temperatures which can curtail the life of standard cells. There is also a **BATTERY/RECHARGEABLE** column indicating whether the supplied cells are disposable ■ or rechargeable batteries ■ and if the headlamp can use other types of cell shown as ☐ for rechargeable option and ☐ for disposable cell options. Check out the '**USB**' column for models easily charged or even usable via laptops, phones, vehicles etc. the oval USB-C will likely become standard but most still use the flat-bottomed mini USB.

BELT MOUNT....
refers to the ability to move the battery pack to your belt or to keep them warm inside clothing while still in use. ☐ = separate battery case that you m*ay* be able to partially dismount. This category DOES NOT include the handful of detachable lights like the Fenix HL50 & HM50R or Nitecore HC30, 33 (pics left) &50 because they cannot be stored in the warm and used at the same time. They will however, take weight off the head which s also a benefit of belt-mounted models. A head that detaches as a handheld light is listed in the NOTES column.

POWER STATUS....
not to be confused with 'Charge-Status' which is how long your depleted cells are taking to charge up. Power Status is given as ■ for constant power status always on view – usually indicated by a series of small LEDs. ☐=power status shows temporarily whenever the light is switched on. Indicates that an incremental power status is shown on request (by pressing a button) and an outline square ☐ indicates that intermittent flashing or an audible beep tells the user that the battery is getting low – some have LEDs *and* an audible or visual reminder.

Water resistance is shown with a black square and is listed under the **IP RATING** where the last number ranges from 1 to 8 with X7 and X8 being submersible. The X in these examples refers to dust ingress and is a number from 1 to 6 but not often given for headlamps.

WARRANTY....
Unlimited Lifetime warranty is shown as ■. Limited lifetime as ☐ but these may only be valid in the country of manufacture – usually the US. A square and a number = a limited time warranty in years OUTSIDE the country of origin. A plus symbol + after a number means the warranty may extend further but will generally exclude the cost of parts.

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IMAGES NOT TO SCALE	MODEL	COMPANY	ORIGIN	COST	WEIGHT inc. batteries	MAX LUMEN	MIN RUN TIME @max power	MAX RUN TIME @min power	FRONT LEDs	SPOT FLOOD VARI	FRONT MODES	REAR LIGHT FLASHING	MAX BEAM DISTANCE CANDELA	ADJ HEAD ANGLE	BATTERIES included	CHARGE TIME	POWER STATUS	USB CHARGER to MINI USB	STD BATTERIES RECHARGEABLE	BATTERY to BELT	REGULATED AUTO LIGHT DIM	SWITCH LOCK	IP RATING	COLOURS	WARRANTY LIFETIME	NOTES	WWW.
	Icon	BLACK DIAMOND EQUIPMENT		£90 $100 €100	300g 10.6oz	500	70h	175h	☐ ☐ ■ ■ ■	■ ■	High, Dimming, Strobe, RGB		125m 410ft		4xAA	-			■	■		■	67	■	3	'Last-used mode' memory	blackdiamond equipment.com
	ReVolt	BLACK DIAMOND EQUIPMENT		£60 $60 €60	97g 3.4oz	300	6h 30h	75h 175h	☐ ☐ ☐ ■ ■	■ ■	High, Dimming, Strobe, Red		80m 263ft		Ni MH or 3xAAA or lithium	4-5h	☐	■ ■	■ ☐			■	X8	■ ■ ■ ■		burn time for NiMH and Alkaline. 'Last-used mode' memory	blackdiamond equipment.com
	Spot 325	BLACK DIAMOND EQUIPMENT		£40 $40 €40	86g 3oz	325	4h	200h	☐ ☐	■ ■	High, Dimming, Strobe, Red		80m 263ft		3xAAA	-			■		■		X8	■ ■ ■ ■ ■ ■ ■ ■		'Last-used mode' memory 2018 Spot 300lm still available	blackdiamond equipment.com
	Storm 375	BLACK DIAMOND EQUIPMENT		£50 $50 €55	120g 4.2oz	375	5h	150h	☐ ☐ ■ ■ ■	■ ■	High, Dimming, Strobe, RGB		100m 328ft		3xAAA	-			■		■	■	67	■ ■ ■ ■ ■		'Last-used mode' memory 2018 Storm 350lm still available	blackdiamond equipment.com
	FL19	COAST		£30 $20	65g 2.3oz	330	3.25h	17h	☐ ☐ ■	■	High Flood Low Flood Red Flood		38m 124ft	■	3xAAA	-			■				X4	■	☐	inc helmet clips. Reflective head-band	coastportland.com
	FL60	COAST		£36 $40	94g 3.3oz	400	2.75h	19h	☐	■	High Flood Med Flood Low Flood		32m 104ft	■	3xAAA	-			■				X4	■	☐	inc helmet clips Reflective head-band	coastportland.com
	FL60R	COAST		£60 $105	94g 3.3oz	450	2.25h	10h	☐	■	High Flood Med Flood Low Flood		33m 108ft	■	Li ion 3xAAA	n/a		■ ■	■ ☐				X4	■ ■ ■ ■ ■	☐	inc helmet clips Reflective head-band	coastportland.com
	FL68	COAST		$50	99g 3.5oz	400	2.75h	19h	☐ ☐ ■ ■	■	High Flood Med Flood Low Flood Rd/Gr Flood		32m 104ft	■	3xAAA	-			■				X4	■	☐	inc helmet clips Reflective head-band	coastportland.com
	FL70	COAST		$40	102g 3.6oz	435	2.5h	16h	☐	■ ■ ■	High Med Low		143m 469ft	■	3xAA	-			■				X4	■	☐	inc helmet clips. Reflective head-band	coastportland.com
	FL75	COAST		£50 $60	105g 3.7oz	435	2.5h	17h	☐ ☐ ■	■ ■ ■	High Med Low Red		143m 469ft	■	3xAAA	-			■				X4	■ ■ ■ ■ ■	☐	inc helmet clips. Reflective head-band	coastportland.com
	FL75R FL78R	COAST		$105	91g 3.2oz	530	2.25h	11h	☐ ☐ ■	■ ■ ■	High Med Low Red		156m 511ft	■	Li ion 3xAAA	n/a		■ ■	■ ☐				X4	■ ■ ■ ■ ■	☐	FL78R=tan. inc helmet clips. Reflective head-band	coastportland.com
	FL80	COAST		$60	128g 4.5oz	615	2.25h	13h	☐	■ ■ ■	High Med Low		183m 600ft	■	3xAAA	2.25h			■				X4	■	☐	inc helmet clips. Reflective head-band	coastportland.com
	FL85	COAST		£70 $70	128g 4.5oz	615	2.25h	13h	☐ ☐ ■	■ ■ ■ ■	High Med Low Red		183m 600ft	■	3xAAA	2.25h			■				X4	■	☐	inc helmet clips. Reflective head-band	coastportland.com

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	FL85R	COAST		$125	128g 4.5oz	700	1.75h	8.5h	□ □ ■	■ ■ ■	High Med Low Red		200m 656ft	■	Li ion 3xAAA	1.75h		■ ■	■ □				X4	■	□	inc helmet clips. Reflective head-band	coastportland.com
	HL8	COAST		£80 $100	362g 12.8oz	615	1.75h	64h	□	■ ■ ■	High Med Low		217m 711ft	■	4xAA	-			■	■			X4	■	□	aluminum bezel. inc helmet clips	coastportland.com
	HL8R	COAST		£140 $175	349g 12.3oz	800	4.25h	62h	□	■ ■ ■	High Med Low		214m 702ft	■	Li ion 4xAA	4.25h		■ ■	■ □	■			X4	■	□	aluminum bezel. inc helmet clips	coastportland.com
	HL27	COAST		£50 $60	195g 6.9oz	360	9.25h	84h	□	■ ■ ■	High Med Low FINITE		132m 433ft	■	3xAA	-			■	□			X4	■	□	inc helmet clips	coastportland.com
	HL40 (HL45)	COAST		£30 $30 ($32)	125g 4.4oz	300 (400)	3.5h	14h (13h)	□ (■)	■	High Low (red)		30m 98ft	■	3xAAA	-			■	□			X4	■	□	inc helmet clips. HL45 has red LED & reflectve headband	coastportland.com
	HL26R	FENIX LIGHTING		£50 $66	86g 3oz	450/ 130	1.3h	25h	□ □ □	■ ■	Low Med, High Burst, SOS		100m 328ft 2564	■ 60°	1600 mAh Li-polymer	3.5h	□	■ ■	■				66	■ ■ ■	□	450lm in short burst only. inc helmet clips, Reflective head-band, Part-alloy.	fenixlighting.com
	HL30	FENIX LIGHTING		£40 $61	123.5g 4.35oz	300	4.5h	200h	□ ■	■	Eco, Low Med, High Turbo, SOS Red, Red Flash		50m 164ft 610	■ 60°	2xAA or NiMH	-			■ □		■	■	67	■ ■	□	Alloy and Plastic head	fenixlighting.com
	HL32R	FENIX LIGHTING		£54 $73	108g 3.8oz	600/ 300	1h/ 4.5hrs	200h	□ ■	■	Eco, Low Med, High Turbo,Burst SOS, Red, Red Flash		73/49m 240/161ft 1333	■ 60°	Li-polymer	4.5h	□	■ ■	■			■	66	■ ■	□	600lm as short bursts. Alloy and Plastic head	fenixlighting.com
	HL40R	FENIX LIGHTING		£60 $80	130g 4.6oz	600/ 400	1.2h/ 4.5h	200h	□	■ ■	Reading, Eco, Low Med, High Burst SOS		147/96m 482/ 315ft 5426	■ 60°	Li-polymer	4.5h	□	■ ■	■			■	66	■ ■	□	600lm as short bursts. Alloy and Plastic head	fenixlighting.com
	HL50	FENIX LIGHTING		£50 $64	74g 2.6oz	500/ 365	n/a	n/a	□	■	High Med Low, Burst		57m 187ft	■ 180°	1xCR123A or AA	-			■		■		X8	■ ■	□	500lm as short bursts. Alloy Stainless Steel head. Head detaches as handheld	fenixlighting.com
	HL60R	FENIX LIGHTING		£75 $98	138g 4.9oz	950	0.74h	100h	□ ■ ■	■	Eco, Low Med, High Turbo, Red		116m 381ft 3396	■ 160°	1x18650 Li ion	3h	□	■ ■	■		■	■	X8	■ ■	□	Alloy head. Turbo mode may cut-out due to temp protection	fenixlighting.com
	HM50R	FENIX LIGHTING		£52 $80	80g 2.8oz	500	2.3h	90h	□	■	Low Med, High Turbo		80m 262ft 1813	■ 180°	1x16340 Li-ion or CR123A	1.5h	□	■ ■	■ □				68	■	□	Alloy Head. Head detaches as handheld	fenixlighting.com
	HP30R	FENIX LIGHTING		£130 $160	385g 13.6oz	1000	4h	400h	□ □ □	■ ■	Low Med, High Turbo		202m 663ft	■ 60°	2x18650 Li ion or 2x CR123A	4h	□	■ ■	■ □	■	■	■	66	■ ■	□	Alloy head. Neutral white sub-LEDs. Battery=ext power supply	fenixlighting.com

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	HL12R	FENIX LIGHTING		£45 $61	73.3g 2.6oz	400/ 130	1h/ 8h	110h	□ ■	■	Eco, Low Med, High Burst Red, Red flash		64m 210ft	■ 60°	1000mAH Li Polymer	8h		■ ■	■		■	■	66	■ ■ ■	□	400lm as short bursts. Alloy/Plastic head. Reflective head-band	fenixlighting.com
	HL55	FENIX LIGHTING		£60 $90	115g 4.1oz	900/ 400	3.75h	150h	□	■	Eco, Low Med, High Burst		116m 381ft	■ 160°	1x18650 Li ion or 2x CR123A	n/a		■ ■	■ □		■	■	X8	■	□	Alloy head, CR123A version =$65 900lm burst	fenixlighting.com
	HP15UE	FENIX LIGHTING		£68 $84	254g 9oz	900/ 400	3.1h	170h	□	■ ■	Eco, Low Med, High, Burst		178m 864ft	■ 60°	4xAA or AA NiMH	-			■		■	■	X6	■	□	Alloy head, 900lm burst	fenixlighting.com
	HP25R	FENIX LIGHTING		£80 $102	217g 7.6oz	1000	1.5h	150h	□ ■	■ ■	Eco, Low Med, High Turbo, Red		187m 614ft 8772		1x18650 Li ion or 2x CR123A	n/a		■ ■	■ □		■	■	X6	■	□		fenixlighting.com
	H14R.2	LEDLENSER		£154 $140 €170	340g 12oz	1000	4h	40h	□	■ ■ ■	Boost,Power Low Power Blink, finite brightness adjustment	■ □	300m 984ft	■ 60°	2x18650 3.7v Li ion or 4 AAA	8h	■ □	■ ■	■ □		■	■	X4	■	7	ledlenser.com ledlenserusa.com	
	MH11	LEDLENSER		€150	179g 6.3oz	1000	4h	120h	□ ■ ■ ■	■ ■ ■	Boost, Power, Medium, Low, Blink, SOS,Strobe, RGB		320m 1050ft	■ 120°	1x18650 3200mAh Li ion	8h	■ □	■ ■	■		■ ■	■	54	■ ■		Programmable. App-driven with bluetooth	
	MH10/ H8R/iH8R*	LEDLENSER		£90 $80	158g 5.57oz	600	10h	120h	□	■ ■ ■	High Med Low	■	150m 492ft	■ 65°	1x18650 3.7v Li ion	6h	■	■ ■	■		■	■	X4	■	7	Programmable. Alloy casing. inc RGB Lenses. *Industrial version has helmet clip	ledlenser.com ledlenserusa.com
	MH7	LEDLENSER		£80 $80 €70	140g 4.94oz	400	7h	60h	□ ■	■ ■ ■	Boost High, Medium, Low, Red		200m 656ft	■	1x Li ion	4.5h		■ ■	■		■	■	54	■ ■ ■	7	Programmable.	ledlenser.com ledlenserusa.com
	MH8	LEDLENSER		£88 $80	140g 4.94oz	400	7h	60h	□ ■ ■ ■	■ ■ ■	Economy, Constant, Red, Green blue Flashing		180m 590ft	■	1x Li ion or 2 AA	4.5h	■ □	■ ■	■ □		■	■	54	■ ■	7	Programmable. Converts to handheld.	ledlenser.com ledlenserusa.com
	MH5	LEDLENSER		£44 $50 €40	92g 3.25oz	400	4h	35h	□	■ ■ ■	Boost,Power Low Power Blink	■	180m 590ft	■	1x 14500 Li ion	2.5h		■ ■	■	■	■	■	54	■ ■ ■	7	Programmable.	ledlenser.com ledlenserusa.com
	H7R.2	LEDLENSER		£88 $90 €90	165g 5.82oz	300	4h	60h	□	■ ■ ■	Boost, HighPower Low Power Blink, finite brightness adjustment	■ □	160m 525ft	■	1x18650 3.7v Li ion or 4 AAA	6h	■ □	■ ■	■	■	■	■	X6	■	7	Alloy casing. inc RGB Lenses.	ledlenser.com ledlenserusa.com
	XEO19R/ iXEO19R*	LEDLENSER		£253*-275 $275* €299	478g 16.86oz	2000	4h	20h	□ □	■ ■	Boost, HighPower Low Power Blink, finite brightness adjustment		300m 984ft	■	4x18650 3.7v Li ion	6h	■	■ ■	■	■	■ ■	■	X6	□ ■ ■ ■*	5	Converts to handheld.	ledlenser.com ledlenserusa.com
	iLH8R	LEDLENSER		$180	(160g) (5.6oz)	300	7h	40h	□	■ ■	High Med Low		160m 525ft	■	1x Li ion	4.5h	□	■ ■	■		■	■	66	■	5	ATEX	ledlenser.com ledlenserusa.com

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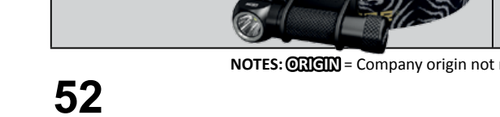
	NEO10R	LEDLENSER		£90 $100	179g 6.3oz	600	10h	120h	☐	■ ■ ■	Low Power Mid Power High Power, Blink	■	150m 492ft	■ 60°	1x18650 3.7v Li ion	6h	■ ☐	■ ■	■	■	■ ■	■	54	■ ■	5		ledlenser.com ledlenserusa.com
	LP346	LUX-PRO		$20	168g 5.9oz	300	4h	6.5h	☐ ☐ ■ ■	■ ■ ■	Spot High Spot Low Spot Strobe Flood Flood Red Flood Green		n/a	■ 45°	3xAAA	-	-		■	☐	■			1		luxproflashlights.com
	LP347	LUX-PRO		$30	150g 5.28oz	400	n/a	5h	☐ ☐ ■ ■	■ ■ ■	Spot High Spot Low Spot Strobe Flood Flood Red Flood Green		n/a	■ 45°	3xAAA	-	-		■	☐	■			1		luxproflashlights.com
	LP355	LUX-PRO		$35	272g 9.6oz	300	n/a	8hrs	☐	■ ■	Spot High Spot Low Spot Strobe	■ ☐	70m 230ft	-	3xAAA	-	☐		■		■		64	■	1		luxproflashlights.com
	Rebel	NEBO		$35	85g 3oz	600/ 240	40s (2h)	4.5h	☐	■	High Low Turbo Strobe		90m 295ft	■ 180°	1x16340 Li-ion	1.5-2h		■ ■	■				X4	■	2	Alloy dead detaches as handheld with belt clip	nebotools.com
	NSP-4616B	NIGHTSTICK		$68	265g 9.3oz	450	3.5h	10.5h	☐ ☐	■ ■ ■	Spot Low Spot High Flood High Flood Low Dual	■	78m 256ft 1500	■ 90°	3AA	-			■				X7	■	☐	Rubber head band	nightstick.com
	NSP-4614B	NIGHTSTICK		$42	166g 5.8oz	300	1.5h	6h	☐ ☐	■ ■ ■	Spot Low Spot High Flood High Flood Low Dual		76m 249ft 1315	■ 90°	3AAA	-			■				X7	■	☐	Rubber head band	nightstick.com
	USB-4708B	NIGHTSTICK		$92	173g 6.1oz	1000	2.25h	6.25h		■	High Med Low Strobe		211m 692ft 11108	■ 90°	Li ion	n/a		■ ■	■					■	☐	Aluminum Housing.	nightstick.com
	Dicata XPP-5462_X	NIGHTSTICK		$100	265g 9.3oz	310	6.75h	25h	☐ ☐	■ ■ ■	Spot Low Spot High Flood High Flood Low Dual	■	120m 394ft 3660	■	3AA	-			■				67	■ ■	☐	ATEX Rubber head band	nightstick.com
	HA20	NITECORE		$55	112g 3.9oz	300	1.75h	160h	☐ ■ ■	■	Ultra Low Low Medium High Turbo Red Red Strobe		110m 361ft 3050	■ 90°	2xAA NiMH or Lithium	-	☐		■		■		67	■	5+	Alloy Head. Last mode memory.	flashlight.nitecore.com
	HA40	NITECORE		£65 $60	227g 8oz	1000	1h	430h	☐	■	Ultra Low Low Medium High Turbo SOS/Caution Strobe		182m 597ft 8300	■ 180°	4xAA NiMH or Lithium	-	☐		■		■		66	■	5+	Alloy Head. Last mode memory.	flashlight.nitecore.com
	HC30	NITECORE		£50 $66	90g 3.2oz	1000	1h	330h	☐	■	Ultra Low Low Medium High Turbo SOS/Caution Strobe		162m 532ft 6600	■ 180°	18650 Li ion or CR123	6h	☐		■ ☐		■		X8	■	5+	Alloy Head unit detaches as handheld. Last mode memory. Neutral or white LED options	flashlight.nitecore.com
	HC33	NITECORE		£74 $65	100g 3.5oz	1800	0.5h	330h	☐	■	Ultra Low Low Medium High Turbo SOS/Caution Strobe		187m 613ft 8750	■ 180°	18650 Li ion or CR123	6h	☐		■ ☐		■		68	■	5+	Alloy Head unit detaches as handheld. Last mode memory	flashlight.nitecore.com

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	HC50	NITECORE		£60	163g 5.8oz	760	1.25h	510h	□ ■ ■	■	Ultra Low Low Medium High Turbo Red Red Strobe		98m 322ft 2400	■ 90°	18650 Li ion or CR123	6h	□	no	■ □		■		X8	■	5+	Alloy Head unit detaches as handheld. Last mode memory	flashlight.nitecore.com
	HC60	NITECORE		£59 $60	132g 4.7oz	1000	1hr	680h	□	■	Ultra Low Low Medium High Turbo SOS/Caution Strobe		117m 384ft 3400	■ 180°	18650 Li ion or 2xCR123	8h	□	■ ■	■ □		■		X7	■	5+	PC & Alloy head. Last mode memory Colour-correct LED or bright white LED options	flashlight.nitecore.com
	HC65	NITECORE		£80 $75	148g 5.2oz	1000	1h	800h	□ □ ■	■	Ultra Low Low, Med High, Turbo Red/Caution Aux White SOS/Caution		110m 361ft 3000	■ 180°	18650 Li ion	8h	□	■ ■	■		■		X8	■	5+	Alloy head. Last mode memory. Colour-correct LED	flashlight.nitecore.com
	HC70	NITECORE		£132 $100	275g 9.7oz	1000	2.25h	220h	□	■	Ultra Low Low Medium High Turbo		182m 597ft 8300	■ 180°	2x18650 Li ion	11h	■	■	■	■	■		67	■	5+	Alloy head. Last mode memory. USB output port. HC90 discontinued	flashlight.nitecore.com
	Adventure 320 (8703)	NITERIDER		$70	87g 3oz	320	1.5h	32h	□ □ □ ■ ■	■ ■	Diffuse, Low Medium, High SOS, Flash, Beacon, Red Red Flash		n/a	■	Li Polymer	2.5h	■	■	■			■	64	■	□		niterider.com
	PRO 2200 8530	NITERIDER		$350	556g 19.6oz	2200	1.5h	25h	□ □ □	■ ■	High, Med, Low,Walk, SOS, Beacon, Flashing		n/a	■	4x7.4v Li ion	5h	■		■	■			64	■	□	Also a 4200lm model $550	niterider.com
	HS2	OLIGHT		£62 $70	115g 4.06oz	400	2.2h	18h	□ □	■ ■ ■	Level 1 (Low) Level 2 Level 3 Level 4 (High) SOS/Beacon		85m 275ft 1800	■	3.7v Li Polymer	3.5h	■ □	■ ■	■	■			X4	■	5	Alloy Head separates as a handheld. Gradual light transition between modes. audible low battery warning at 10%	olightworld.com
	H16 Wave	OLIGHT		£52 $60	115g 4.06oz	500	2h	160h	□ □	■ ■	Level 1 (Low) Level 2 Level 3 (High)		100m 328ft 2500	■ 45°	3.7v Li Polymer	3.5h	■ □	■ ■	■	■			X4	■	5	Hands-free beam activation. Reflective head-band	olightworld.com
	H2R	OLIGHT		£80 $90	64g 2.26oz	2300	1.8h	50h (45days*)	□ □	■	Level 1 (High) Level 2 Level 3 Level 4 (Low) Level 5* SOS/Beacon		153m 501ft 5800	■ 180°	1x18650 li ion	-		■	■				X8	■	5	Magnetic USB charging base. *level5=1 lm	olightworld.com
	2780	PELICAN		£75 $56	249g 8.8oz	430	1.5h	12h	□ □	■ ■	High, Med, Low, Spot, Downcast Flashing	■ □	124m 407ft 3868	■ 60°	4xAA	-	■	-	■	■	■	■	X7	■ ■ □	■	3 changeable head covers/ colours inc luminous	pelican.com peliproducts.co.uk
	2780R	PELICAN		£103 $115	207g 7.3oz	558	2h	7.5h	□ □	■ ■	High, Med, Low, Spot, Downcast Flashing	■ □	127m 417ft 4060	■ 60°	1x18650 Li ion	6h	■	■	■	■	■	■	X7	■ ■ □	■	3 changeable head covers/ colours in luminous	pelican.com peliproducts.co.uk
	Actik	PETZL		£43 $50 €50	92g 3.35oz	300	60h	260h	□ ■	■ ■	Max Autonomy Standard Max Power Proximity Red Strobe		90m 295ft	■	3xAAA or NiMh or Li-ion	-			■ □				X4	■ ■ ■	5	Headband has emergency whistle. Reflective head-band	petzl.com
	Actik Core	PETZL		£55 $70 €70	82g 2.9oz	350	2h	160h	□ ■	■ ■	Max Autonomy Standard Max Power Proximity Red Strobe		95m 312ft	■	1250 Ah Li-ion or NiMh or 3xAAA	3h		■	■ □				X4	■ ■	5	Reflective head-band and emergency whistle	petzl.com

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	Duo Z1	PETZL		£325 $450 €420	370g 13oz	360/ 300	7h	23h	□ □	■ ■ ■	Reserve, Map, Proximity, Movement, Distance, Boost		115m 377ft	■	6400 mAh Li ion	8h	■ □		■		■ □	■	67	■	3	ATEX. switch lock is electronic.360lm is temporary boost mode only. Switches to reserve to indicate battery is low	petzl.com
	Duo Z2	PETZL		£213 $250 €232	360g 12.7oz	430/ 220	2h	15.5h	□ □	■ ■ ■	Ambient, Proximity, Movement, Distance, Boost		120m 394ft	■	4 xAA or NiMh or Li-ion or Ni Cd	-	□		■		■ □	■	67	■	3	ATEX 430lm is temporary boost mode only. Switches to reserve to indicate battery is low	petzl.com
	Duo S	PETZL		£326 $450 €430	370g 13oz	1100	3.5h	23h	□ □	■ ■ ■	Ambient, Proximity, Movement, Rapid Movement Distance, Boost		200m 656ft	■	3200 mAh Li-ion	4h	□		■		■ □	■	67	■	3	Switches to reserve to indicate battery is low	petzl.com
	Myo	PETZL		£80 $110 €81	168g 5.9oz	370/ 280	n/a	50h	□	■ ■	Constant Standard 10 incremental light modes		105m 345ft	■	3 xAA or NiMh or Li-ion or Ni Cd	-	-	-	■ □		■	■	X4	■	3	370 lm only in temp boost mode. Switches to reserve to indicate battery is low.	petzl.com
	Nao +	PETZL		£160 $200 €180	185g 6.5oz	750	1.5h	15h	□ □	■ ■ ■	Reactive, Constant, Multi, Trail-run, Climb, Trek,Backpack	□	140m 459ft	■	3100 Amh Li-ion	6-8h	□	■ ■	■		■ ■	■	X4	□	3	Uses Bluetooth. Rear light visible for 1km. Switches to reserve to indicate battery is low. Programmable.	petzl.com
	Reactik+	PETZL		£96 $120 €95	115g 4oz	300	2.5h	15h	□ □ ■	■ ■ ■	Reactive, Constant Max Autonomy Standard Max Power Red Strobe		110m 361ft	■	1800 Ah Li-ion or NiMh or AAA	4.5h	□	■ ■	■ □		■ ■	■	X4	■ ■	3	Switches to reserve to indicate battery is low	petzl.com
	Tactikka	PETZL		£28 $30 €30	86g 3oz	200*	60h	240h	■ □	■	Max Autonomy Standard Max Power Proximity Red Strobe		60m 197ft	■ 45°	3xAAA or Li-ion	-		-	■ □		■		X4	■ ■	5	Tactikka is a 200 lumen headlamp and should therefore be in part 2 not this issue but it's better than an empty row.	petzl.com
	Tactikka Core	PETZL		£49 $55 €52	82g 2.9oz	350	2h	160h	□ ■	■ ■	Max Autonomy Standard Max Power Red Proximity Red Strobe		95m 312ft	■ 45°	1250 Ah Li-ion or NiMh or AAA	3h			■ □				X4	■	5		petzl.com
	Apex APX550	PRINCETON TEC		£116 $94	279g 9.8oz	550	2h	150h	□ □ □ □ □	■ ■ ■	Spot High Spot Low Flood Strobe Flood High Flood Low		120m 394ft	■ 90°	4xAA Lithium	-	■ □		■ □		■		X7	■ □ ■	10		princetontec.com
	Apex Extreme APX550-EXT	PRINCETON TEC		£134 $108	416g 14.7oz	550	2.5h	200h	□ □ □ □ □	■ ■ ■	Spot High Spot Low Flood Strobe Flood High Flood Low		120m 394ft	■ 90°	8xAA Lithium	-	■ □		■ □	■	■		X7	■ ■	10	'Remote' battery pack can be worn on belt or kept warm in clothing	princetontec.com
	Apex Industrial APX-BK-IND	PRINCETON TEC		£120 $102	279g 9.8oz	550	1h	150h	□ □ □ □ □	■ ■ ■	Spot High Spot Low Flood Strobe Flood High Flood Low		120m 394ft	■ 90°	4xAA Lithium	-	■ □		■ □				X7	■ ■	10	Intrinsically safe Helmet mount kit included	princetontec.com
	Apex Pro APX550-PRO	PRINCETON TEC		£23 $105	173g 6.1oz	550	1.5h	35h	□ □ □ □ □	■ ■ ■	Spot High Spot Low Flood Strobe Flood High Flood Low		120m 394ft	■ 90°	2xCR123 Lithium	-	■ □		■ □		■		X7	■ ■	10		princetontec.com
	Apex Rechargeable APX450-RC	PRINCETON TEC		£198 $160	283g 10oz	450	5h	90h	□ □ □ □ □	■ ■ ■	Spot High Spot Low Flood Strobe Flood High Flood Low		120m 394ft	■ 90°	Lithium ion	6h	■ □	■	■ □	■	■		X7	■	10	also Industrial ver-sion with helmet kit $175	princetontec.com

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	**Remix/** RMX300 **Remix Industrial*** HYB-IND	PRINCETON TEC		£53/£58 $43/$50	83g 2.9oz	300	28h	150h	□ ■ ■ ■	■ ■	Spot High Spot Low Flood High Flood Low		73m 240ft	■ 180°	3xAAA	-	-	-	■				X4	■ ■ ■ ■	5	Remix Black= White & R,G or B LEDs. Remix Tan & Camo = White&RedLED *Ind+Helmet kit	princetontec.com
	**Remix Pro** RMX300PRO	PRINCETON TEC		£80 $62	66g 2.3oz	300	10h	116h	□* ■ ■ ■	■ ■	Spot High Spot Low Flood High Flood Low		58m 190ft	■ 180°	1xCR123	-	-	-	■				X4	■ ■ ■	5	*Options include White with 3xred, 1R,G InfraRed or Red Blue InfraRed LEDS	princetontec.com
	**Remix MPLS** RMX150PRO-NOD	PRINCETON TEC		£120 $80	66g 2.3oz	300	6h	24h	□* ■ ir ■ ■	■ ■	Spot High Spot Low Flood High Flood Low		73m 240ft	■ 180°	1xCR123	-	-	-	■				X4	■ ■ ■ ■	5	*Options include White + red/green/ blue +InfraRed flashing. NVG & Molle	princetontec.com
	**Vizz** VIZZ350 **Vizz Industrial*** VIZZ-IND	PRINCETON TEC		£66/£72 $53/$61	92g 3.2oz	420	1h	136h	□ □ □ ■ ■	■ ■ ■	Spot High Flood High Red High		78m 256ft	■ 90°	3xAAA lithium NiCad, NiMh	-	■ □		■ □		■	■	X7	■ ■ ■ ■ ■	■ 10	*Ind+Helmet Kit Also a Mossy Oak Gamekeepers' version	princetontec.com
	**Vizz Tactical/** VIZZ-TAC **Vizz Tac MPLS** VIZZ-MPLS	PRINCETON TEC		£88/£157 $71/$100	92g 3.2oz	420	110h	125h	□ ir ■ ■ ■	■ ■ ■	Spot High Spot Low Red High Green High Blue High IR High		78m 256ft	■ 90°	3xAAA lithium NiCad, NiMh	-	■ □		■ □		■		X7	■ ■ ■	■ 10	Programmable. MPLS = NVG & Molle compatible	princetontec.com
	**Cross Trail 5**	SILVA		£80 €100	230g 8.1oz	500	6h	90h	□ □ ■ ■	■ ■	Max Medium Minimum Blink		130m	■	4xAA lithium NiCad, NiMh	-	■ □		■ □	■	■ ■		X5	■	2	Three Cross Trail models:. 5, 5X & 5x Ultra. All with part-alloy heads	silva.se
	**Cross Trail 5x (5X Ultra)**	SILVA		£109 €120 (£153) (€170)	161g 5.7oz (<246g) (<8.7oz)	500	4h (6-8h)	8h (25-90h)	□ □ ■ ■	■ ■	Max Medium Minimum Blink		130m	■	1 x 2.4Ah Li Polymer	4h	■ □	■ ■	■ □	■	■ ■		X5	■	2	*5 Ultra h*as both battery options in 2 supplied battery packs+ separate rear red lamp.	silva.se
	**Exceed 2X (Exceed 2XT)**	SILVA		£315 €375 (£400) (€400)	306g 10.8oz (504g) (17.8oz)	2000/ 1500	4h (12h)	40h (100h)	□ □ □ ■ ■/■/■	■ ■	Boost Max Medium Minimum Blink Red/Grn/Ornge		175m	■	1 x 3.3Ah Li-ion (1x 9.9Ah Li-ion)	4h (10h)	■ □	■ ■	■ □	■	■ ■		X5	■	2	2000=boost only Part Alloy head. Inc bike & helmet mounts. 2XT lacks red/grn LEDs	silva.se
	**Explore 3 (Explore 3X)**	SILVA		£50 €55 (£70) (€80)	88g 3.1oz (73g) (2.6oz)	350	45h (2.5h)	55h (20h)	□ □ ■/■	■ ■	Max Minimum Blink Red/Orange		75m	No	3xAAA (700 mAh Li-polymer)	(2.5h)	□ □	(■)	■ (■) □	■	■ ■		X7	■	2	part Alloy head. Explore 3X = re-chargeable version of Explore 3	silva.se
	**Scout RC**	SILVA		£55 €50	76g 2.7oz	320	5h	25h	□ □ □ ■ ■	■ ■	Max Minimum Blink Red		60m	■	1x 1Ah Li-Polymer	3h	□	■ ■	■ □		■		X5	■	2	Alloy head	silva.se
	**Scout XT**	SILVA		£36 €40	84g 2.9oz	320	30h	190h	□ □ □ ■ ■	■ ■	Max Minimum Blink Red		60m	■	3xAAA	-	□	■ ■	■ □		■		X5	■	2	Alloy head	silva.se
	**Trail-Runner 4**	SILVA		£65 €75	122g 4.3oz	350	25h	90h	□ □ ■ ■	■ ■	Max Medium Minimum Blink		75m	No	3xAAA	-	□		■ □	■	■		X5	□	2	Three Trail Runner models: 4, 4X & 4X Ultra, all 3 have alloy heads	silva.se
	**Trail-Runner 4X (4X Ultra)**	SILVA		£80 €90 (£243) (€300)	133g 4.7oz	350	5h (5-25h)	18h (18-90h)	□ □ ■ ■	■ ■	Max Medium Minimum Blink		75m	No	1 x 2.4Ah Li-Polymer	4h	□	■ ■	■ □	■	■		X5	■	2	*4X Ultra h*as both battery options in2 supplied battery packs+ separate rear red lamp.	silva.se

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	Trail Speed 3XT	SILVA		£243 €299	247g 8.7oz	800	5h	10h	☐ ☐	■ ■	Max Medium Minimum Bike Blink		130m 426ft	■	1 x 3.3Ah Li-ion	4h	■ ☐	■ ■	■ ■	■	■ ■		X5	■	2	Alloy head. Inc bike & helmet mounts.	silva.se
	Protac HL	STREAMLIGHT		$135	188g 6.6oz	635	1.75h 1.75h	36h	☐	■	Flood High Flood Medium Flood Low		184m 604ft 8500	■ 90°	2xCR123a lithium	-			■		■		X4	■	☐	Programmable. Aluminium Case. rubber strap and elastic cradle	streamlight.com
	Protac HL USB	STREAMLIGHT		$189	230g 8.1oz	1000	1.5h	20h	☐	■* ■	Spot High Spot Medium Spot Low *Flood High *Flood Medium *Flood Low		232m 761ft 13500	■ 90°	Lithium ion	5h		■	■ ☐		■		X4	■	☐	Aluminium Case. rubber strap and elastic cradle. *R,G & Flood lens	streamlight.com
	TwinTask 3AA	STREAMLIGHT		$79	216g 7.6oz	300	11h	25h	☐	■ ■	Spot Spot/Flood Flood		121m 397ft 3680	■ 120°	3xAA or 3xAA lithium	-			■				X4	■		This model is now 275 lm so should really be in pt2	streamlight.com
	TwinTask USB	STREAMLIGHT		$105	173g 6.1oz	375	4.75h	20h	☐	■ ■	Spot Flood		121m 397ft 3650	■ 120°	Lithium ion	4.5h		■	■ ☐	■			X4	■			streamlight.com
	Minimus	SUREFIRE		£210 $200	113g 4oz	300	1.5h	75h	☐	■	13 modes from 5-300lm inc SOS		32m 105ft	■ 180°	1xCR123A	-			■					■	☐	Magnesium alloy Case. Includes a Red lens filter	surefire.com
	Maximus	SUREFIRE		£288 $280	145g 5.1oz	1000	1h	70h	☐	■	finite brightness adjustment		89m 291ft	■ 90°	lithium-ion	n/a	■ ■		■				X4	■	☐	Magnesium alloy Case.	surefire.com
	ProSafe HDL6R	UNILITE		£65	94g 3,3oz	350	3h	59h	☐ ☐ ☐ ☐ ☐	■	High, Medium, Low, Flash		27m 88ft	■ 45°	1800mAh Li Polymer 3xAAA	4h	■	■	■ ☐				X6	■			uni-lite.com
	ProSafe HDL9R	UNILITE		£106	275g 9.7oz	750	4h	260h	☐	■ ■ ■	finite brightness adjustment	■ ☐	100m 328ft	■ 45°	2 x 3.7v 2000 mAh 18650 Lithium	6h	■	■	■			■	X6	■		Dimmer switch.flip-down Anti-dazzle screen.	uni-lite.com
	ProSafe HL6R	UNILITE		£80	191g 6.7oz	450	4.5h	96h	☐ ☐	■ ■	High, Medium, Low, SOS, Flash		129m 424ft	■ 45°	2600mAh 3.6v Li ion or 2xAA	3.5h		■ ■	■ ☐				X6	■			uni-lite.com
	Brila 450	UST ULTIMATE SURVIVAL TECHNOLOGIES		$30	105g 3.7oz	450	2h	40h	☐ ■	■ ■	High Medium Low SOS Strobe Red Red Strobe		23m 75ft	■	3xAAA	-			■				X4	■	☐		ustbrands.com
	Brila 550	UST ULTIMATE SURVIVAL TECHNOLOGIES		$45	198g 7oz	550	4.5h	55h	☐	■ ■	High Medium Low SOS	■ ☐	160m 525ft		3xAA	-			■				X4	■	☐		ustbrands.com
	Brila 580	UST ULTIMATE SURVIVAL TECHNOLOGIES		$60	95g 3.35oz	580	2.5h	18h	☐ ■	■ ■	High Medium Low Red Red SOS		150m 492ft	■	Li ion 3xAAA	2.5h		■ ■	■ ☐				X4	■	2		ustbrands.com

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Terrain Based Probability Models for SAR part 1

by Matt Jacobs

Matt is a Wilderness EMT with the Bay Area Mountain Rescue Unit (BAMRU) in California, and the creator of CalTopo / SARTopo.

CONTENTS

1 ABSTRACT

In order to examine the effect of terrain on search and rescue (SAR) find locations, incidents from the International Search and Rescue Incident Database (ISRID) were compared against a variety of geospatial data. Unlike most SAR research to date, find-locations were examined independent of a subject's last known location or possible travel route. Notable variations in find-probability relative to terrain were observed, as well as differences in the find-locations of injured and uninjured subjects.

Main Pic: Seven Mountain Rescue Teams, (Buxton, Derby, Edale, Glossop, Kinder,Oldham and Woodhead MRTs) plus Derby Cave Rescue and Search Dog assets cover the Peak District National Park in the UK. It is an area of around 555 sq miles of mixed upland terrain easily accessible to adjacent population centres and therefore prone to a high volume of lost-person searches thanks to receiving over 10 million visitors a year. Photo by UKphotoguy

2 INTRODUCTION

Much of our understanding of land search theory derives from work done by the US Navy and Coast Guard, originating with submarine hunting during WWII and subsequently applying that knowledge to maritime SAR. While the techniques developed by these agencies are generally applicable to land SAR, one fundamental difference is the presence of terrain and man-made features. Open water searches have a smooth probability density distribution, in which small changes in position result in small changes to the probability of a find. In land SAR, by contrast, the chance of a find can vary significantly with small changes in position.

Broadly speaking, land searches are accomplished using two techniques: **linear feature searches**, such as those along a trail or stream, and **area searches**, in which searchers walk a uniformly spaced grid. On land, searcher speed and spacing will also vary throughout an operation, with fast searching for a responsive subject generally giving way to slow, careful searching for an unresponsive one as time goes on. Due to a lack of linear features, open water searches are primarily grid based. A narrower variety of techniques are generally employed on each search, as a responsive individual in open water is only moderately easier to spot from the air than an unresponsive one. Additionally, open water conditions are more consistent - swell height does not change over short distances to the degree that vegetation does.

In the presence of smooth distributions for both subject location and search conditions, the most effective method is a uniformly spaced gridded area search. To maximize the efficiency of this technique, the maritime SAR community has expended significant effort developing smooth large-scale probability distributions based on factors such as wind and current. There has also been considerable research on the distances over which various objects can be seen for given ambient conditions, resource types and searcher speeds.

Mirroring this, there has been effort within the land SAR community to develop smooth large-scale probability distributions based on factors such as expected travel distance, elevation change and dispersion angle. There has also been some research, primarily funded by the Department of Homeland Security (DHS), on the distances at which various objects can be seen in different types of vegetation. If for no other reason than funding, neither of these subjects have been as thoroughly researched as in maritime SAR.

Even so, despite the major differences between land and maritime environments, comparatively less effort has gone into researching the impact of terrain on subject behavior. I am not aware of any research that quantifies those effects; Robert Koester's *Lost Person Behavior* lists find percentages for various features and track offsets, but without knowing the composition of the search areas reported on, those numbers can not be translated into find probabilities.

I addressed this by looking at the relationship between find locations and a variety of man-made and natural features. Where most research to date has focused on the relationship between the find location and a person's last known point (LKP), I chose to examine find locations in isolation. This decision was partially driven by the limited number and quality of reported LKPs, but also because questions such as "how likely is someone to be found in a drainage" can be answered independent of a subject's possible travel route.

For each subject category presented in Lost Person Behavior, a statistic such as distance travelled is listed if it has been reported for at least 14 incidents. While this may be adequate for reporting on population statistics, the methods used in this paper require more data. For example, determining a stream's probability from the number of near-stream finds is analogous to determining how a dice is weighted by rolling it repeatedly. Additionally, I wanted enough incidents to analyze not only the dataset as a whole, but also to subdivide on factors such as subject status and distance travelled.

Because most categories lacked a sufficient number of find-locations, only the largest group of categories; hikers, hunters and gatherers, was used. Additionally, the small proportion of urban finds were discarded, and only backcountry incidents were analyzed.

Terrain features examined include roads, trails, streams, lake shores, coastlines, elevation, slope angle, land cover, ridges and drainages. Non-linear man-made features such as buildings and trailheads were not considered. It seems plausible that features might follow some kind of tiered hierarchy, with for example streams only being relevant to off-trail finds. However, as there is no evidence to support this, the dataset was generally not filtered when looking at features presumed to be lower probability.

2.1 LIMITATIONS

Three quarters of the find locations studied came from Oregon, with the remainder from New York and Arizona. Additionally, most analysis was focused on backcountry incidents involving the ISRID hiker, hunter and gatherer groups. The applicability of these results to other locations, terrain types and subject categories is an open question.

While this article falls under an area of research often referred to as lost person behavior, that name is a bit misleading. No attempt has been made to differentiate between subjects who injure themselves in a drainage and stay put, and those who wander downhill into a drainage once injured.

This article explores a relatively new avenue of research; the results presented here are ripe for further analysis using improved techniques and larger sample sizes. While I hope the rough sketch will withstand the test of time, it seems inevitable that some of the finer-grained conclusions may eventually be invalidated.

2.2 SEARCH THEORY

The classic approach to search management is to:

1. Establish the search area
2. Segment the search area
3. Assign probabilities to each segment

Every search begins with an Initial Planning Point (IPP) representing the subject's last known position. The search area is established as a circle centered on this point, with a radius derived from several sources including historical lost person behavior data from ISRID. This search area is then divided into non-overlapping searchable areas called segments.

Each segment is assigned a Probability of Area (POA) reflecting the likelihood that the subject is within that area. A parallel concept to POA is probability density, or PDEN. The units for PDEN are (probability) / (unit area), and it is generally expressed in real units by dividing a segment's POA by its size, e.g. percentage probability per square kilometer.

Actual search efforts are characterized by a conditional Probability of Detection (POD), the probability that a team would have found the subject if the subject were actually within the searched segment. In uniform terrain, POD can be determined using the range at which searchers are likely to see the subject (effective sweep width) and distance travelled by searchers.Underlying these concepts is the assumption that within each segment, all points are equally likely to contain the subject - mathematically, segments are assumed to have uniform PDEN. In theory, features that cause large steps in PDEN (e.g. trails) have already been searched during the initial (hasty) phase, and gradual PDEN changes are handled through well-placed segment boundaries.

However, there is no established standard for identifying high-probability hasty features. The two major search management textbooks, NASAR (p 204) and ERI (p 253), provide lists that collectively include roads, trails, streams, rivers, creeks, drainages, ridges, lines of little resistance, power lines and clearings, as well as unspecified attractions, hazards and likely spots. While this list far outstrips the resources available in a typical hasty search, no indication is given as to their relative priority.

As a search progresses, some of these hasty features are broken out into linear segments for high POD searching, but there is no established guide for weighting their POA as compared to nearby areas. Further, there is no evidence-based standard from which to develop area segments that will have a uniform PDEN distribution.

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Since this article is looking at find-locations without regard to an established search area, it is impossible to express PDEN in real-world units. Instead, PDEN is presented as (% probability) / (% search area). As any randomly chosen 1% of the search area has a 1% chance of containing the subject, all terrain has a default PDEN of 1. In this sense PDEN can be used a multiplier - a PDEN of 4 for areas within 100' of lakes would mean they are 4x more likely to contain the subject than randomly chosen terrain.
The actual POA for a given lake shore can only be determined by combining the terrain based models presented here with traditional distance based behavior models.

3 TECHNIQUES

Find locations were compared against two classes of data:

- **RASTER** (a grid of values, like an image)
- **VECTOR** (points, lines and polygons).

Raster data includes elevation and land cover; vector data includes roads, trails and streams.
For both data types, find-locations need to be considered in the context of their surrounding terrain; a finding that half of all subjects are located within 100m of a road is more useful in a wilderness area than one criss-crossed with logging roads. For an incident database containing many find-locations within a constrained geographic area, such as a small national park, it might be possible to compare find-locations against the park as a whole. For example, comparing the percentage of hikers found in clearings against the percentage of parkland occupied by clearings would help determine how strongly clearings predict the find location. Although he was not looking at the predictive values of terrain, see Jared Doke's 2012 paper for an example of such a constrained-area analysis.

The ISRID dataset is too geographically sparse for this approach, and the results would be biased towards the terrain in which people go missing. In short, knowing that most hikers are found in the forest would help you search the state for a missing hiker's car, but is of little predictive value once an IPP is established.

An alternative approach is to generate a uniformly distributed set of points ("sample points") within a given radius ("surrounding circle") of each find-location, and then compare the find-location against the sample points. In this article, the median IPP find-distance (2km) was used as the surrounding circle radius. Finds can be compared directly against their individual surrounding circles, or against all surrounding circles as a whole.

Using the latter approach, PDEN for a given criteria (e.g. "near trails") can be determined using (% of find-locations matching criteria) / (% of sample locations matching criteria). Where road and trail datasets are incomplete, the derived PDEN will still be valid as long as there is no correlation between find-locations and dataset errors. As an extreme example, if half of all roads are missing from the dataset, half of the on-road finds would be misclassified as off-road, but because a similar percentage of search terrain would likewise be classified as off-road, the ratio would remain the same.

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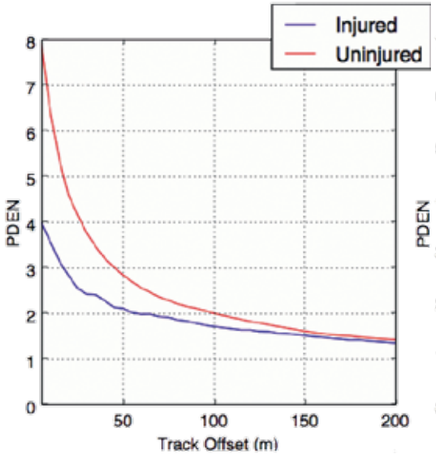


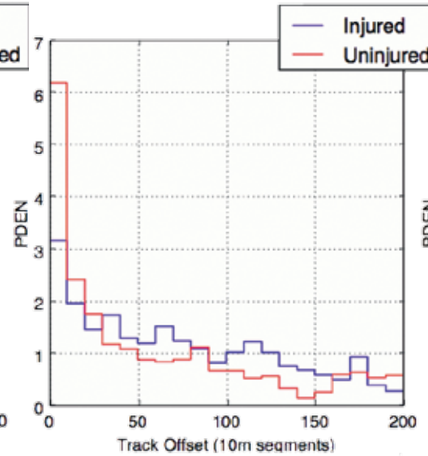


Figure 1a CUMULATIVE *Figure 1b SEGMENTED*
Example PDEN plotted against track offset from man-made linear features, by subject status.

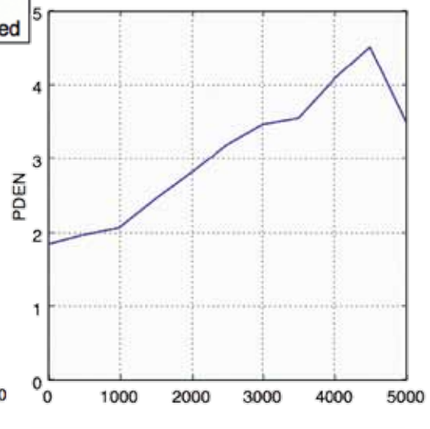


Figure 2 : Example PDEN for a 40m track offset as a function of distance from the IPP.

3.1 LINEAR FEATURES

One of my primary goals was to answer questions like

- what percentage of people are found on trails? and
- what is a trail's PDEN?

Implicit in both of these questions is the ability to look at a point and categorize it as being either "trail" or "not trail". This is a challenging question in itself, but further complicated by positional errors in both reported find locations and the datasets those locations are compared against. While some finds 10 meters from a road may be on-road finds with positional errors, others may be someone who suffered a stroke, walked off the road and is not easily detected via hasty search.

Existing SAR research has approached this problem using the concept of track offset. Simply put, a track offset is the shortest distance from a point to a linear feature. It can be used to assign a number to a single point ("this location is 20m from the nearest road"), or to describe an entire set of points ("all points within 20m of a road"). Searching a feature to a 100m track offset actually requires searching a 200m wide strip - 100m to the left of the feature, and another 100m to the right. While Lost Person Behavior only applies track offset to finds not actually on a particular feature, points can never truly be "on" the 1-dimensional line data used in this study. Instead, all points are given a track offset, including those incredibly close to linear features.

Back to the question of trail PDEN and "on trail" finds, the problem can be visualized by plotting PDEN against track offset. A cumulative PDEN plot (**Figure 1a**) shows PDEN for the entire track offset; a cumulative PDEN of 2 at a 50m offset would mean that if you search everything within 50 meters of a feature, you can expect a PDEN of 2. The cumulative graphs presented here start at a track offset of 5 meters and have additional data points at 5 meter intervals, out to 200m.

A segmented PDEN plot (**Figure 1b**) shows PDEN for incremental changes in track offset; assuming 10 meter increments, a segmented PDEN of 2 at a 50m offset means that if you search only between 40 and 50 meters of a feature, you can expect a PDEN of 2. The segmented plots presented here generally use 10 meter increments, but may use larger ones for small datasets.

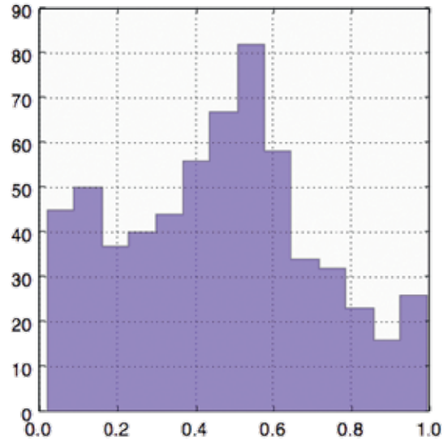
While segmented plots provide a better picture of the way PDEN changes with track offset, they are inherently noisier than cumulative ones. It's important to look a the overall trend and not the small fluctuations from one incremental track offset to the next. This noise can also make it harder to compare multiple lines - for example, injured and uninjured subjects - on the same plot. Ultimately both segmented and cumulative plots are useful in forming a coherent picture of the data.

It can also be useful to look at how PDEN changes in relation to a second variable such as distance from the IPP. This can be accomplished by picking a fixed track offset, for example 40 meters, and plotting PDEN within that offset against the second variable. Because PDEN can only be calculated from a collection of find locations, each point on the X axis represents a range of values (a "window"). A PDEN of 2 for a distance of 1000m would mean for all finds within a distance of 1000 ± the window size, the 40m cumulative PDEN was 2. To reduce noise, the windows overlap by 50%; if the X axis has 500m increments, the window size is 750m.

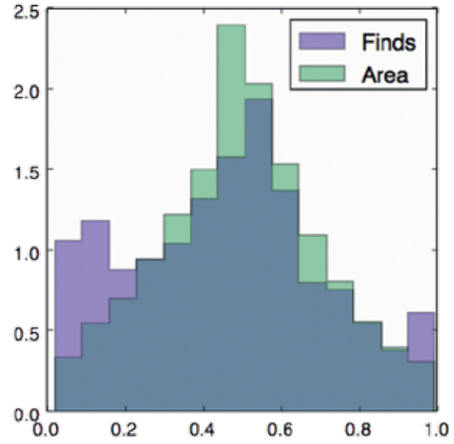
3.2 RASTER DATA

Track offset is not a meaningful concept for raster data like elevation and land cover. While it is possible to determine each point's distance from a non-linear feature such as a summit or meadow, this paper instead uses the direct value a point lies on, and not its offset from some other feature.

While a point's raw numerical value can be used in some cases,



a) Histogram of percentile basis elevation for find locations.



b) Percentile basis elevation for find locations (blue) compared to sample points (green).
(c-below) Segmented PDEN for percentile basis elevation

Figure 3: Figure 3a shows that percentile basis elevations of 0.4-0.6 are most common for find locations. Without context, this could lead one to conclude that midpoints have a higher PDEN than high and low points. Figure 3b superimposes this graph against all search terrain, showing that find locations are more likely to be high or low points than randomly chosen terrain. Figure 3c plots PDEN against percentile basis elevation, showing the opposite of what one might conclude from Figure 3a.

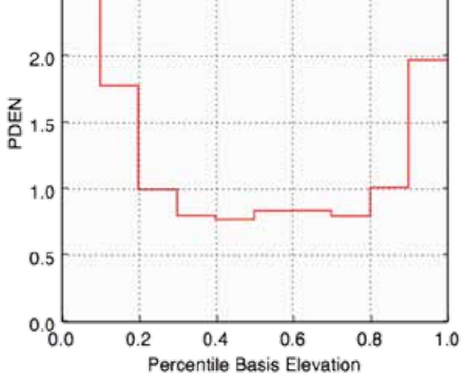
it's often useful to look at that point in relation to its surrounding terrain. Elevation is a good example, as it's meaningless to compare raw find elevations between coastal and mountainous areas. One alternative is to rank points against their surrounding terrain on a percentile basis; a 0.05 (5%) rank would mean that a point is lower than 95% of its surrounding circle.

If find-locations and sample points are all given percentiles basis values, PDENs can be generated. For example, if 20% of find- locations have a percentile basis below 0.1, but only 5% of search terrain does, then those low-lying areas have a PDEN of 4 (20% / 5%). As with track offset, percentile basis PDEN can be shown on a segmented plot. An increment of 0.1 (typical for this article) would show PDEN for percentile basis values of 0-0.1, then 0.1-0.2, etc.

Figure 3 illustrates these concepts using percentile basis elevation. More finds are located mid-slope than at high or low points, suggesting that mid-slope locations might be better places to search. However, once find locations are compared to nearby sample points, it becomes obvious that mid-slope points in general outnumber high and low points, and that the extremes of elevation are actually better places to look.

3.2.1 Significance

In any observational study or experiment, there is always a possibility that seemingly interesting results could have happened purely by chance. Typically a test statistic, such as



a normal curve, is used to determine how likely this is to have happened. If it is unlikely that the results could have happened by chance, they are considered statistically significant; the cutoff for significance is generally 5%, i.e. a 1/20 chance that the results are random noise.

In this article, sample points are used as a control. If 10% of search terrain is near streams, and streams have no effect, then one would expect roughly 10% of finds to be near streams. Due to random chance, the number of near-stream finds is unlikely to be exactly 10%, especially for smaller sample sizes. Instead, the distribution of find percentages within a fixed track offset of streams will follow a binomial distribution, with each incident representing a separate binary experiment.

The number of finds matching a given criteria (e.g. near streams) is only significant if it exceeds the relevant binomial distribution's 95th percentile. If 10% of the search terrain is near streams

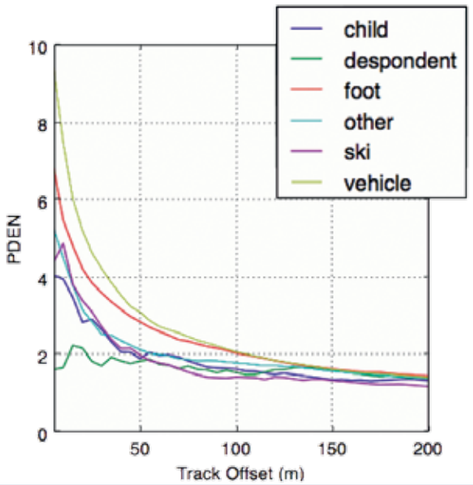


Figure 4: Cumulative road and trail PDEN, by subject category, back-country incidents

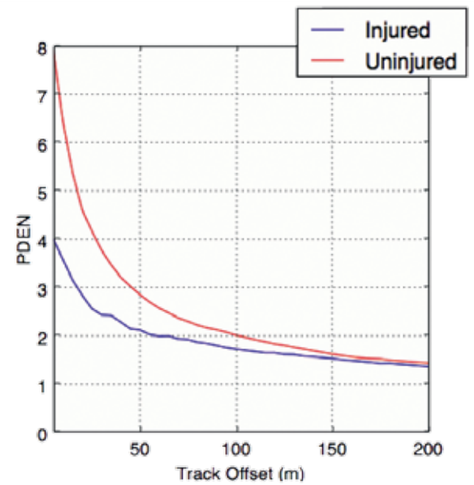


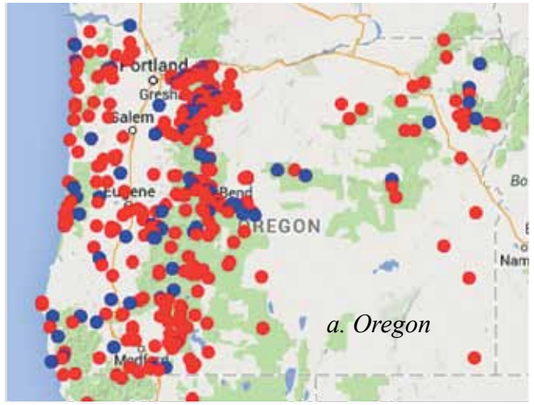
Figure 5: Cumulative road and trail PDEN, by subject status, backcountry incidents

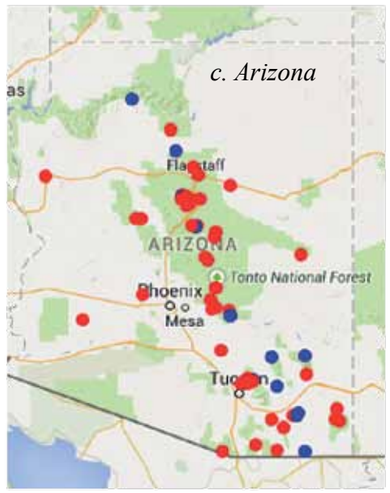
and 100 find locations are examined, this distribution will have number of tries n = 100 and probability p = 0.1; in this case, the 95th percentile works out to 16. Put another way, if you made a game out of randomly throwing 100 darts at a map, 19 out of 20 times you would hit streams with fewer than 16 darts.

Another useful way to measure results is margin of error. Margin of error takes an outcome (percent of finds near streams, percent of voters in favor of a candidate) and provides the range you would expect 19 out of 20 repeated polls or experiments to lie within. Keeping with the example above, if 16 out of 100 finds are located near streams (n = 100, p = 0.16), the margin of error is roughly 7%, and the 95% confidence interval runs between 9% and 23%.

Unlike most regression analyses, the significance test described above is one-tailed (i.e. a 5% chance of being over the significance level). The margin of error, however, is two-tailed (2.5% chance of being under the margin and 2.5% chance of being over the margin). Even though the lower band on the margin of error is below the 10% of terrain occupied by streams, the results are still significant.

Figure 6: Incident Locations





In keeping with standard practices, probability densities will be reported ± the standard error, which is 1/2 of the margin of error. A PDEN of 5±1 means that if it were somehow possible to roll back time and repeat the studied searches hundreds of times, then 2/3 of the time you would expect PDEN to fall between 4 and 6.

A final question examined in this article is the relationship between two groups: if a greater percent-age of group A is found near streams than group B, are the results significant or just noise? Rather than being determined by overlapping margins of error, this is instead evaluated by checking if the difference between the means of each group is greater than 1.96 SEA2 + SEB2, where SE is the standard error for each group.

In this article, PDEN margin of error was determined by establishing the margin of error for find percentages and then dividing by the percentage of search terrain. The percentage of search terrain matching a given criteria is assumed to be accurate and not assigned its own confidence interval.

4 RESULTS

4.1 INCIDENT DATA

This article looks at incidents from the International Search and Rescue Incident Database (ISRID) that lie within the contiguous US (CONUS); only incidents with coordinates for the find location are used. Some of those incidents also have coordinates for an initial planning point (IPP). While the IPP is nominally a subject's last known location, there is much variation in the quality of IPPs reported to ISRID. An IPP may be the point at which someone wandered off from a group, a trailhead, or even a residence. The variable IPP quality, combined with the low number of reported IPPs, led me to focus primarily on find locations and not on paired IPP and find coordinates.

The CONUS dataset has roughly 2200 incidents with reported find locations. Most incidents are from Oregon, with several hundred each from New York and Arizona. Of those, 1636 are on-land cases with an incident type of search (subject location not known at beginning of incident) or rescue (subject location known at beginning of incident); the remainder are mostly on-water incidents, with some aircraft crashes and other categories. Based on land cover data (see section 4.6), 181 incidents were discarded due to having surrounding circles that were at least 25% developed. The 1455 (89%) remaining backcountry incidents were retained for further evaluation.

Each incident has an ISRID-provided status, also called outcome, of either well, injured or DOA. Due to limited numbers of injured and DOA subjects, they were examined together and are simply referred to as "injured" within this paper. While injured spans all major injuries, from walking wounded to fully unresponsive, status is assumed to have some correlation to mobility and responsiveness, as neither of those are tracked within ISRID.

ISRID also provides an eco-region domain for each incident (polar, temperate, dry or tropical), and Lost Person Behavior relies heavily on eco-region for modelling subject behavior. Because most of Oregon and all of New York are temperate, and all of Arizona is dry, eco-region is heavily tied to US state within the examined dataset. To prevent over-generalization, results will generally be broken down by state rather than eco-region.

4.1.1 BACKCOUNTRY INCIDENTS

Of the 1455 backcountry incidents examined, 903 (62%) were searches and 552 (38%) were rescues, i.e. the subject location was known at the beginning of the incident. Searches had significantly lower injury rates (81% well, 9% injured, 10% DOA) than rescues (44% well, 51% injured, 5% DOA).

Each incident has an ISRID-provided subject category, such as hiker or hunter. To keep sample sizes large, similar categories were evaluated together as category groups. At 622 incidents, the largest backcountry category group is hikers, hunters, gatherers and runners, who roughly represent able-minded adults traveling on foot in non-technical terrain; they are collectively referred to as the foot category group. The next largest category group is vehicles, with 297 backcountry incidents, followed by skiers and snowboaders (79), children (55) and despondents (47). All remaining category groups comprise 355 backcountry incidents. As **Figure 4** shows, PDEN for roads and trails varied by category group, with vehicles having the highest PDEN and despondent individuals having the lowest. It also varied by subject status (**Figure 5**), with uninjured subjects having a higher road and trail PDEN than injured ones.

Throughout this article, only the foot category group was examined in detail.

4.1.2 FOOT INCIDENTS

Research was focused on backcountry incidents from the foot category group, comprising 622 find locations. Incident types were 71% searches (subject location not known at beginning of incident) and 29% rescues (subject location known at beginning of incident). Subject categories within the group were 74% hikers, 14% hunters, 11% gatherers and 1% runners.

For reference, the locations of these incidents are shown in **Figure 6**. Incident locations are color coded by status, with uninjured subjects represented by red dots and injured or deceased subjects represented by blue dots.

4.2 ROADS AND TRAILS

Roads and trails, collectively referred to as manmade linear features, were sourced from two datasets.

One is OpenStreetMap (OSM), an open source, publicly editable map database. Features in it have been both drawn by hand and added in bulk from government data. As a result, OSM data comprehensiveness varies geographically; some areas contain every logging spur, and others have almost no forest roads.

Within national forest lands, OSM data was supplemented by

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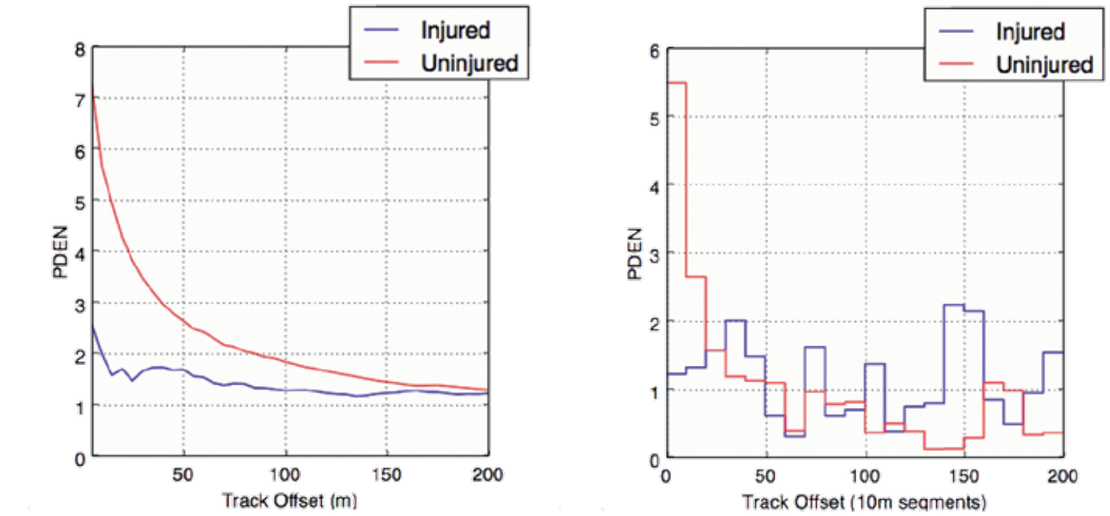
Figure 7: Road PDEN. Uninjured subjects had a high road PDEN that dropped off more rapidly with track offset than injured ones.



the US Forest Service's FSTopo Transportation dataset. Because the two datasets were used alongside each other, and because mapping errors cause the same feature to appear in slightly different locations in each dataset, some areas appeared to be more road and trail dense than they actually are. At the same time, many features are missing from both datasets entirely, especially newer trails or public land managed by agencies other than the Forest Service.

For both roads and trails, mapping errors mean that real-world track offsets are probably lower than reported here, especially for close by finds. It is also likely that trails are less accurately mapped than roads, with the difference between real-world and computed trail offsets being comparatively greater.

4.2.1 ROADS

Across both searches and rescues, road PDEN was found to vary by subject status, with uninjured subjects more likely to be found on or near a road (**Figure 7**). PDEN decreased more rapidly with track offset for uninjured subjects than injured ones, suggesting that injured subjects are comparatively more likely to be found near, rather than on, roads. Uninjured subjects had a road PDEN of 4.50.4 at a 20m track offset and 30.2 within 40m. Injured subjects had a small but still significant (p = .02) PDEN of 1.50.3 at a 40m offset.

4.2.2 TRAILS

Injured subjects appeared to have a flatter distribution, with proportionately more finds at track offsets of 20m-40m. Although the 20m-40m PDEN difference was statistically significant, it is also a cherry-picked result and could easily be due to chance. Although trail PDEN is shown here for all incidents, the pattern was similar when examining only off-road (> 40m track offset) find locations. Uninjured subjects had a trail PDEN of 81 at a 20m cumulative offset and 5.50.5 at 40m. Injured subjects had a PDEN of 7.51 at 40m.

4.2.3 OTHER FACTORS

Man-made linear feature PDEN generally increased with both vertical relief and IPP-find distance (**Figure 9**). As an example, near man-made finds increased from 30% of incidents within 2km of the IPP to 53% beyond 3km, and from 32% in areas with less than 1000' of relief to 46% elsewhere. Although these trends ceased at the extremes of both relief and distance, sample sizes at those extremes were small. In terms of find probability, the IPP was of no predictive value beyond its use in standard distance-based models. The IPP's proximity to man-made features had little correlation to IPP-find distance (Figure 23b in Part 2) or the find location's proximity to man-made features (Figure 11 also in Part 2). The increase in man-made PDEN with distance also occurred for both on and off trail IPPs.

The influence of subject status on PDEN at wider track offsets (i.e. injured subjects being near features rather than on them) became more apparent when discarding rescues and looking only at searches (**Figure 10a**). However, it remains unclear whether this is an appropriate technique; often the only difference between a search and a rescue is the subject's ability to summon help.

4.2.4 BY STATE

Looking at individual states, roads had noticeably lower PDEN in New York than in Arizona and Oregon. New York also had no off-road incidents within 40m of a mapped trail. This is likely due

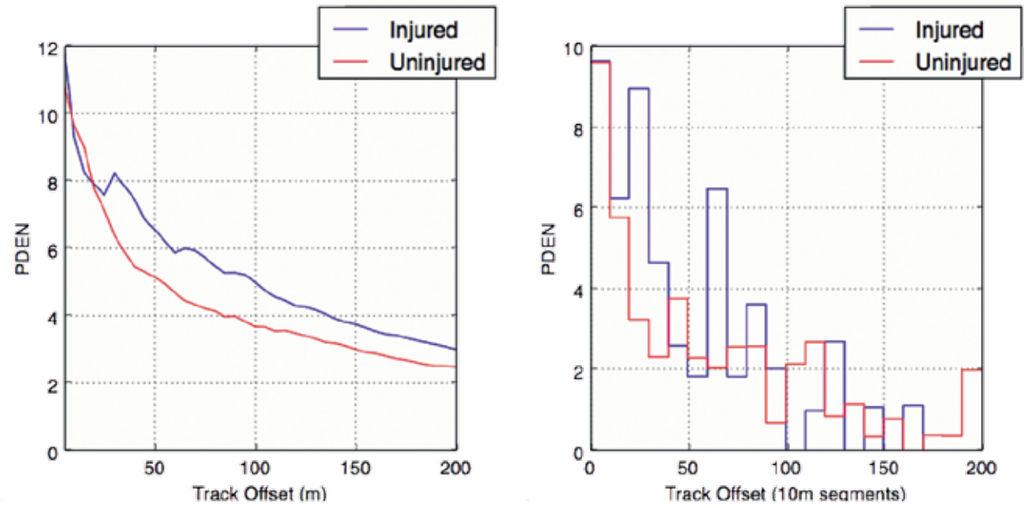


Figure 8: Trail PDEN. Probability was not affected by subject status to the same degree as road PDEN.

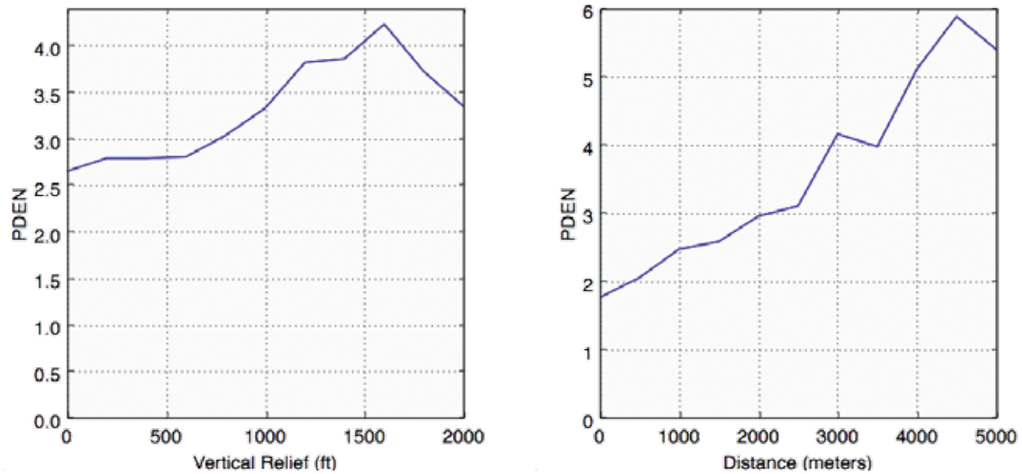


Figure 9: Effect of other factors on man-made linear feature PDEN. PDEN generally increased with both vertical relief (left) and IPP-find distance (right), although it declined at the extremes of both.

to data coverage issues, especially since the Adirondacks are managed at the state level and not mapped by the Forest Service, but the discrepancy may be worth further investigation.

4.2.5 SUMMARY

Trails had a significantly higher PDENs than roads, especially for injured subjects. Since only foot incidents were considered, this seems reasonable - people are more likely to hike on trails, and drive when roads are available. However, I would not use this finding as a reason to prioritize trails over roads when they are both likely travel paths. It is probable that injured subjects were comparatively more likely to be near - rather than on - roads and trails, but this finding warrants further investigation.

Data for this research was provided by dbS Productions, maintainers of the ISRID database. Materials costs were covered by a grant from the **Mountain Rescue Association** *(MRA).*

Next Issue - PART 2 including water, elevation, ridges and drainage.

NORDIC Pocket Saw

by **Richard Hackwell**

Rich is Deputy Head of Coastal Operations for HM Coastguard in the UK and has been a coxswain and lifeguard with a Beach Rescue Team for over 20 years. He was also a member of the UK's first Technical Rescue Unit as well a being a qualified arborist reaching the status of Senior Arb Officer for a regional authority.

INTRODUCTION

The Nordic Pocket Saw from Sweden is a manual chainsaw chain with handles which is pulled backwards and forwards across the wood to effect a cut. Unlike a powered chainsaw, this one is light weight and fits in your pocket yet remains incredibly efficient as a cutting tool. If you look on line this saw has scored highly with woodsman, 4x4 drivers and outdoorsmen alike. This success has led to a push into the Rescue market, so what does it offer? Most reviews of this item talk about felling small trees in the woods, back country logging or clearing paths or trails of fallen trees or obstructions for people or vehicles. In rescue terms we may well be required to undertake similar tasks in clearing access to a site or removing hazards. In addition to these more traditional tasks we may require hands saws for rescue specific tasks:

- Gaining access to a casualty.
- Freeing trapped casualties
- Clearing a work zone for rescue operations (rope or water)
- Clearing strainers in water rescue.
- Clearing obstructions in search operations.
- Clearing debris or to help access or egress.

This will involve cutting a variety of wooden materials including: woody undergrowth/ brush, trees (branches, stems, trunks and logs), fallen trees and limbs (green wood and dead wood), construction timber, fence posts etc. These cuts may be required in awkward areas, in poor light and in poor weather conditions or semi submerged in water.

As part of this test we cut various materials (sawn timber, fence post, green and deadwood, live branches) and used it in a variety of scenarios (debris pile, storm blow, fallen trunks, in water). Examples of the size of materials cut: Green hardwood circa 10cm (4”). Green softwood log circa 18.5cm (17.25“). Sawn treated timber and fence posts 8cm (3“).
As the most comparable piece of kit in many peoples rescue tool kits, We have primarily compared this to a folding saw.

CONSTRUCTION

The 65cm/25.6" chain is made from heat-treated high carbon steel and features double cutter teeth on every major link, providing effective cutting in both directions (33 teeth in all). It has Heavy duty nylon handles (ours in rescue orange, naturally) which provide comfortable and safe grip. The chain and handles are strength-tested to 5,940 Newton (about 600 kilo/1335 pounds of force). The saw itself weighs 132g/0.3lb plus 48g for the standard nylon case which includes a belt loop.

IN ACTION

Generally this cuts very well, the teeth are arranged so they cut in both directions, so each pull results in cutting. Like cutting any wood with a hand saw, it's hard work, but if you can get into a good position, the tool cuts quickly and effectively. As with most things except Olympic sprint events, steady wins the race. It's easy to come hard out of the gate and then slow up on bigger timber! The design lends itself to allowing operation by two people which may be of use to share effort and to facilitate a better cutting position or allow greater control of the member being cut because you both have a free hand. The handles are comfortable but you can try adding a handle of round wood to pull against. Although not mentioned in the instructions, they can be extended with webbing or a prusik to facilitate a better cutting position. The bright orange made it easy to see and grab the non-sharp bit when feeding the tool around the object to be cut, especially when working in debris on the floor, water or low light. Also available in red or green.

The wood needs to be secured when cutting or you end up rolling the timber. If the object is not secured by its size or position you will need to foot it, find a friend or secure it.
In rescue terms the likelihood is that you're trying to cut an immobile target, to make it mobile so this may be less of an issue, although you may need to secure or ‘foot’ more flexible sections to allow the saw to do its work. For obvious reasons you can’t control what you're cutting single handed, so care must be taken and consider where your target will fall once it's cut. With a two man team sharing the work and one cutting, one handling the timber you could work very effectively, while clearing reasonable sized wood.

In reality, a folding saw does smaller limbs or wood as well

if not better because it only requires one-hand allowing better control of what you're cutting. The pocket saw will do all the fixed blade can do effectively but has the advantage that it can cut through much larger sections of timber. This tool will cut timber which my folding saw could only be used to carve my initials in.

When coming to the end of a cut the target often becomes difficult to manage because the wood no longer supports the chain in a good cutting arc. This means that either you have to change the cutting angle of the saw or break the last section off the remaining hinge of wood. When cutting a larger section or log, it seems to help the final section if you widen the V of the chain towards the end of the cut, this widens the section the teeth can bite into. Also on bigger sections, while momentum is maintained, the chain doesn’t snag but if you have to stop, it can be difficult to re-start and you may need to ease the chain out of the cut and re-start with some fresh cutting to get back to where you left off. Of course, in a rescue scenario it will generally be the case that when the final bit of the cut becomes fiddly you have already achieved the main objective and good old brute strength and ignorance will finish the task by kicking out the obstruction, snapping the final section or manual handling it out of the way. You may also find that the last part of the cut will tear from the remaining section... not an issue for most but the old arborist in me screamed at the poor finishing cut on live wood!

DIFFICULT ACCESS CUTS: The chain can be fed around objects which means logs on the ground or with little work space behind them can be dealt with more easily than using a fixed saw-blade. The cutting face is only towards the object you're cutting so is potentially safer if cutting around hazards or a casualty. This will also aid cutting wood which is up against an obstruction or in restricted space.

LOW NOISE: As a hand tool it is obviously quieter than powered options, therefore this may have benefits if working around nervous casualties, animals or where compromising comms may hamper rescue or casualty care.

WATER RESCUE: I was keen to see what this might offer to a water rescue team

who often have to consider cutting tools but are restricted in space and capacity for carrying tools. The tool cuts well in water, the design gives some reassurance that you are only cutting what you have put the chain around, as in-water visibility can be poor which is compounded by the saw dust in the water. This may sound odd to the uninitiated but blind-cutting with a fixed blade or chainsaw can so often mean 'nicking' anything else in close proximity to the cut. This flexible hand saw is far more precise in its placement. The Nordic Saw is good for cutting away debris or clearing an access on banks and would be useful for cutting strainers or obstructions in water. Its compact size means it can be easily stowed in a PFD while being quick to deploy. It certainly fits in my PFD pocket easier than a folding saw. It would be a useful addition to a water teams tool-kit or carried on a rescue craft but keep it oiled and well-dried after use.

WEAR GLOVES! I managed to catch myself with the chain when cutting at a difficult angle and hadn’t worn gloves. This is easier done than I originally thought and was reassured to see from other reviews that I was not alone, with others receiving similar injuries. In practice, for use in rescue work even though you use the handles for the actual cutting you will handle the chain a fair bit when placing the tool and unjamming it, therefore gloves are a must.

CONCLUSION

The whole package is very lightweight. The case is simple but stores the chain ready for use. It works well threaded on a belt, in a kit pouch or in a larger pack. Keeping the tool clean and oiled between use appears to be a sensible and prudent practice. It can be sharpened in a similar way to its powered brethren but without the solid bar to push against is a considerably more long-winded job. Good care should allow a long working life. As with all tools, if you are considering issuing the Nordic Saws make sure you get additional units for training and familiarisation, the more you use items of kit like this the more uses you find and the more tricks you learn to achieve the task with it. This also keeps the operational ones clean and sharp for operations. Am I going to ditch all my reciprocating saws and powered chainsaws? No, but this piece of kit definitely has its place. It is not the panacea to all your wood cutting needs, but nor is this a one-trick pony. It can have a valuable place in your tool kit and with the right training and mindset can be of use for; water, rescue, rope rescue, extrication, rope rescue, wilderness SAR or permanently stowed on a vehicle/ boat for dealing with the unexpected. I’m definitely adding one to my personal pack, just in case. COST: £45 / $57 /€50

www.nordicpocketsaw.com

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