"Leave No Trace"

A Philmont Bear Bagging System that Eliminates the Impact on Philmont Trees

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Some would say that the impact to the tree is insignificant when your crew ties its bear bag ropes Perhaps for your one crew, but now multiply that by 20+ crews that leave base camp EVERY DAY during the summer. Over a few years the bear cable trees can sustain significant wear and tear. This article describes an efficient, leave-no-trace bear bagging system designed for our 2009 Philmont crew with the goals:

- To create a system where a single person could raise and lower the bear bags and thus improve the safety, speed, and effort of the Philmont bear bagging.
- Eliminate damage to Philmont's trees caused by tying ropes to the trunk
- Eliminate the potential of ropes getting tangled with other crews on the trunk
- Eliminate the need to tie off to two different trees, which is done to decreases the possibility of a bear undoing one line and dropping the bags, but complicates the process of lowering the bags
- Eliminate (or reduce) the need for an oops bag by making the main bag easy to raise
- Simplify the process of sorting food, and gear from a single large bear bag back into the crew's individual backpacks
- Make the system stronger and weigh less than a single standard issue Philmont bear rope, which is 150ft of ¼" nylon rope that weighs 2 ½ lbs and has a tensile strength of 1200 pounds.

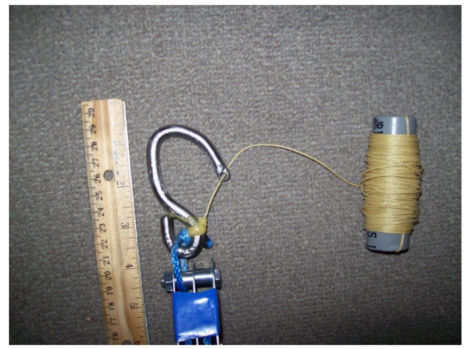
As a starting point to reduce the weight of the system, I contacted Doug Prosser who wrote an article in Backpacking Light Magazine titled, "**Boy Scout Gear List: Philmont Scout Ranch, New Mexico, Summer."** He responded:

> "Philmont provides bear bags and bear ropes. We have always taken their bear bags and ropes until this year. During our 2007 trek Paul Mergens told me about a new lightweight alternative to the provided bear ropes that he was using after getting confirmation from Doug Palmer the Head Philmont Ranger that it was OK. Paul used **Amsteel Blue Ropes 2.5mm (7/64 in)** w/ tensile strength of 1600 pounds and weigh less than 0.5lbs/150ft. He stated that the ropes performed well with no wear. Because of small diameter he stated the scouts did need to use a small stick with the rope wrapped around to haul the heavy bear bags up. Different lengths have been recommended but I would do the main rope at 150 feet and oops rope at 100 feet. **A number of crews including ours used these ropes in 2008 with great success."**

Using the lightweight Amsteel Blue rope is a great way to save weight and pack space, but it has the drawback noted above that the rope is both slick and of small diameter, which makes it hard to lift heavy loads. A solution to this problem is to use a four pulley block and tackle. We went to a hardware store and purchased a four pulley block and tackle. The four pulley system gives a 5:1 reduction in the force. Thus a 100 lb load only requires 20 lb of pull to lift – an easy task for even a younger scout, which is important because we had several 14 year old scouts in our 2009 crew.

The use of a block and tackle solves the first goal, but creates a new problem that is how to attach the upper part of the block and tackle to the bear cables hung at Philmont camps. One approach is to throw a doubled rope over the cable and pull the block up to just below the cable then tie the two rope ends to two separate trees. This works, but doesn't solve our next three goals; in particular, it does not reduce impact on the Philmont trees.

To attach the block to the cable we created a special steel hook whose design has four properties



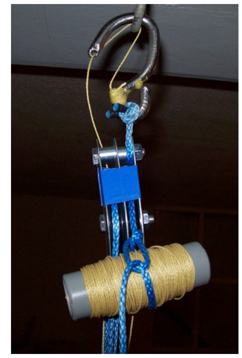
1. when lifted up to the cable it will hook on
2. when loaded with a bear bag, it cannot unhook
3. when unloaded a quick pull (like on a window shade) will unhook it from the cable
4. has no moving parts to fail, freeze, or jam; works simply based on the special shape of the hook.

The hook, shown in the figure, was made from a 3/8" bar of stainless steel. The throw string passes through a hole at the tip of the hook and is tied to the eyelet at the bottom of the hook. Design details are described below.

To lift the hook and top part of the pulley system up to the cable we tied a 40 foot string onto the hook and wound it around a 3 ¼ " long piece of 1" diameter conduit pipe. This plastic pipe serves three functions in our bear bag system. It is the spool that the string is wrapped around to prevent the string from becoming a tangled mess in the bag. It is the throw weight that allows the scout to easily toss the string over a 20 foot high cable. (The string is permanently tied through the center of the pipe to prevent it from being lost when thrown.) And third, the pipe serves as the "stick" used to secure the bag after it is lifted as described in the next section.

The special hook allows us to attach the block and tackle to the cable without the need to tie any ropes to trees, but we still have the rope in the block and tackle that is pulled down on to lift the bag. Traditionally, this rope would be tied off to a tree and the argument would be made that this rope would have less impact than a traditional Philmont tie-off due to the 5:1 reduction in load on it. But our goal is to eliminate damage, not just reduce it. So we came up a solution based on a technique used in the Pacific Crest Trail (PCT) bagging method.

Let's first review the PCT method. It is a very nice method to use when there is a limb at least 20 feet off the ground, and the bear bag is reasonably light. The method uses a carabineer and a stick. The carabineer is used to hook the bear bag to one end of the lift rope. The rope is thrown over the cable (or limb) and run back through the carabineer. The load is lifted to the cable and then the stick is tied (with a simple loop) as high as possible on the rope being pulled down on. The rope is slowly released until the stick has traveled up and hung across the carabineer. Note that the bear bag is coming down while the stick is going up, hence the need to have a limb at least 20 feet high for the bag to still be over 10 feet off the ground when the stick stops the bag from coming lower. To lower the bag, the rope is pulled down on (lifting the bag back up to the limb, hence the reason it works best with a light bear bag as opposed to a 100 lb Philmont crew bag). Once the stick is in reach, it can be pulled out and the simple loop will untie itself. The bag can now be lowered all the way to the ground.

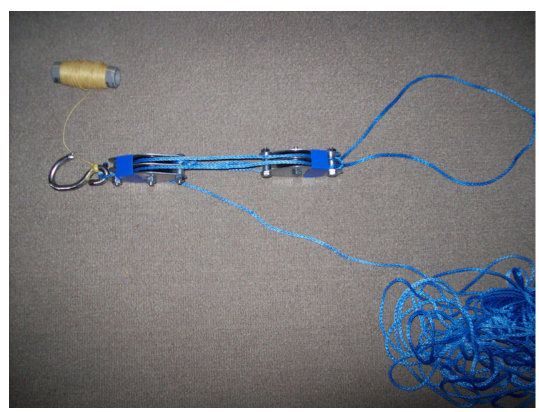


Back to our Philmont bear bag system. A block and tackle is “hooked” to a cable that is between 15 and 20 feet off the ground. The rope is pulled down to easily lift the bear bag to the cable. Our string spool is tied to the rope with a simple loop (in place of the stick in the PCT method) and the rope slowly released until the spool hangs across the pulley assembly as shown. Since there is a 5:1 reduction in load, there is also a five to one reduction in the distance the bag lowers for every foot the pull rope goes up. For example, every 10 feet the stick goes up, the bag only comes down two feet. Thus our system can work with cables as low as 15 feet.

To get the bag down, pull down on the rope, lifting the bag back up to the hook, pull the stick out, the loop unties itself and the bag can be lowered all the way to the ground. Since the block and tackle makes the main bag no harder to lift than an Oops bag, our bear bag system makes it possible to eliminate the need for a separate Oops bag. The main bag can just be lowered to put in those last minute late-night items and then be raised back up even by one person.

Until bears evolve to have opposable thumbs so they can pull a rope down hand over hand and then remove a stick tied to the rope, this method of securing the bag off the ground is actually more bear resistant than the standard double tie-off “Philmont way.” The system eliminates having to tie any ropes to the Philmont trees.

The final step in our simplification process was to eliminate having to dig around in a large bear bag trying to find the smellables bag with the morning coffee in it, or the toothbrush a scout “forgot” to get something out of his smellables bag after dinner. We had each boy use a dry sack for their smellables bag, and had them write their name on the bottom. The sack was big enough to hold 4 days of food plus their other smellables. This decision served multiple purposes. By having the food inside an airtight dry sack inside their pack it reduced the chance of getting food smells inside their packs. By having everything inside the smellables bag, the boys just needed to reach in their pack and pull out that one bag when it was time to raise the bear bags. The dry sacks are waterproof so the contents of each member’s smellables bag stays dry during those afternoon showers at Philmont.



We tied a short loop of Amsteel rope to the bottom pulley assembly. The buckle of each crew member’s dry sack was clipped around this loop of rope. If anyone needed “something”, he could see his name on the bottom of his dry sack, lower the set of bags, unclip just his, remove (or put in) the item, reclip his bag, and raise the set of bags back up. This set up eliminated having to carry the large (but admittedly lightweight) Philmont bear bags.

Our entire 2009 Philmont bear bag system weighed only 20 oz and met all the goals we set out to achieve. It is an efficient, leave-no-trace bear bagging system that eliminates all impact on Philmont trees.

2.0 Hook Design Details

The key innovation in the Philmont bear bagging system we created for our 2009 Trek was a hook that has a special shape that allows it to hook onto the bear bag cable when lifted to the cable, can't unhook when loaded with the bear bags, but when unloaded can be easily unhooked and lowered to the ground. Figure 2.1 shows the key dimensions. Dimensions A and B are key for hooking, C and D are key for staying hooked, and the hole in the tip is key for unhooking.

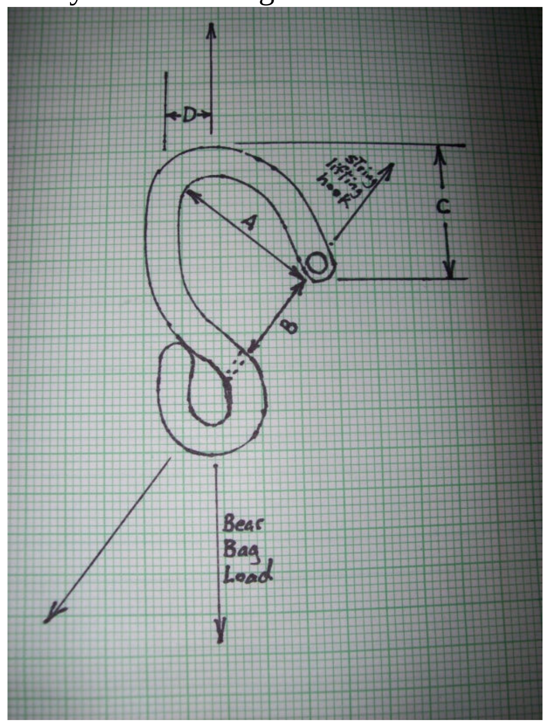


Figure 2.1 Four key dimensions of hook

Distance A: When the hook is being lifted by the string it sits at an angle formed by the hole in the tip and the eyelet. Tilt paper till B is straight up and down to see how it looks and notice that the hook is tilted over such that it can hook on the cable easier. When the tip is just above the cable, (note that the cable will lie along A) the hook only touches the cable a distance A from the string. This causes a torque that rotates the hook onto the cable. For a given size hook you want A to be large. **Distance B:** (Make several times larger than the cable diameter) When hooking and unhooking the cable needs to slip through this gap. When unhooking, the string running along B gets more leverage if B is larger.

Distance C: When the hook is on the cable, the cable goes to the highest point and the hook rotates so that it is straight up and down as shown by the line labeled "Bear Bag Load". By making C large it makes it very hard for the hook to come off the cable by the wind or people swinging the bags back and forth. The bags would have to be swinging in greater than a 160 degree arc for our designed hook to come off. We could not do this even when we tried during testing. For a given size hook you want C to be large.

Distance D: When the hook is on the cable, the highest bending load on the hook occurs over the portion of the hook marked by D. By making D small it becomes very hard for the hook to be "opened up" and fail due to a high overload on the eyelet. In our design D is quite small and allows the 3/8" stainless steel hook to easily hold several hundred pounds without bending.

The final key feature of the hook is the hole drilled in the tip. It need not be a drilled hole, it could be a ring welded on the tip, or a smaller diameter rod bent into an eyelet attached to the tip. What is necessary is to have a hole that the string can pass easily through and be tied to the main hook eyelet. I had trouble on early prototypes with the string getting frayed as it moved back and forth over the sharp edges of the drilled hole. I eliminated this by rounding and sanding the edges of the hole smooth on the final hook design.

Figure 2.2 shows a photo of the hook I made based on trying to simultaneously optimize all the key dimensions shown in figure 2.1. I don't know if it is an optimal shape based on the four dimensions, but it does work pretty well. For those who want to build a copy of this hook, the grid paper the hook is sitting on is 1 cm grid paper so you can read off all the dimensions. For example, the hook is 5.0cm wide and 8.3cm high. It is not necessary for the dimensions of your copy to be exact. The hook will still work fine even if your dimensions differ from the photo by 0.5cm.

Figure 2.2. Photo of hook on 1cm grid paper

Besides the shape of the hook, the way the lift string runs through the tip and ties to eyelet is critical to making the hook easy to unhook from the cable. Pulling on the string pulls the cable out of the unloaded hook. The string does not have enough leverage to pull the cable out of a loaded hook. A second idea I learned the hard way is to put a bit of glue on the knot tying the string to the eyelet, because if the string ever comes untied, the hook is stuck on the cable 20 feet high. At that point you have to lift a crew member to the cable to get the hook and retie the string.

3.0 Instructions for Using the Bear bag system

Block and tackle systems are notorious for getting the rope braded up with itself. This happens when the block and tackle are allowed to flip end over end. When this happens one has to pull the rope out of all the pulleys, untangle the rope, then rethread the rope through the block and tackle. The best way to prevent tangling is to always keep the block and tackle pulled up against each other, especially when stored in the rope bag.

Steps for raising and securing the bags:

1. Open rope bag and grab the throw spool, hook, and bottom pulley system. Lay the block and tackle and hook assembly on the ground under the cable, making sure the ropes running between the pulleys are not tangled. Leave the rest of the rope in the bag to keep it clean.
2. Unroll about 10 feet of string from spool, and throw the spool over the cable.
3. With one foot on the bag loop to keep the lower pulleys near the ground, pull on the string to raise the hook (and upper pulleys) to the cable. As the pulleys go up, the 150' rope is pulled out of the bag. Be sure to deal with any tangles and knots as they come out of the bag. Do not let them get up to the pulley and jam it. As the hook gets to the cable be sure it doesn't get caught on the wrong side of the cable. If it does just let it down a few inches and raise it back up. When the tip is just above the cable, let off on the string a little and the hook will hook onto the cable.
4. Pull on lift rope to raise the lower pulleys about waist high. Clip everyone's smellables bags to the bag loop. Then continue to lift the bags up to the upper pulleys.
5. Reach down and pick up the string spool. Tie a simple loop in the lift rope and slip the spool in the loop to keep the knot from coming undone.
6. Slowly let off on the lift rope until the spool hangs on the upper pulley assembly.
7. Take the rope that is on the ground and tie it up a few feet off the ground to keep small animals from climbing up the rope to the food.

Steps for lowering bags and packing up bear system:

1. Pull down on the lift rope until you can reach the spool tied to the rope. Pull out the spool and the knot will untie itself.
2. Lower the bags to the ground. And unclip them from bag loop.

3. *Key step:* Pull on the throw string until the hook (but not the upper pulleys) raises up and pulls over the cable (see figure). Release the string and the hook will pop back over the cable and the entire assembly can be lowered slowly to the ground with the throw string.
4. With one person holding the top assembly, and another the bottom, pull the lift rope to draw the top and bottom assemblies together to reduce the chance of tangling ropes when placing in the bag.
5. Pull the throw string back over the cable. Watch to be sure the spool doesn't hit you. Wind the pull string back on the spool so it doesn't get tangled in the bag.
6. Stuff the rope into the rope bag, then the assembly, and finally the spool of throw string.