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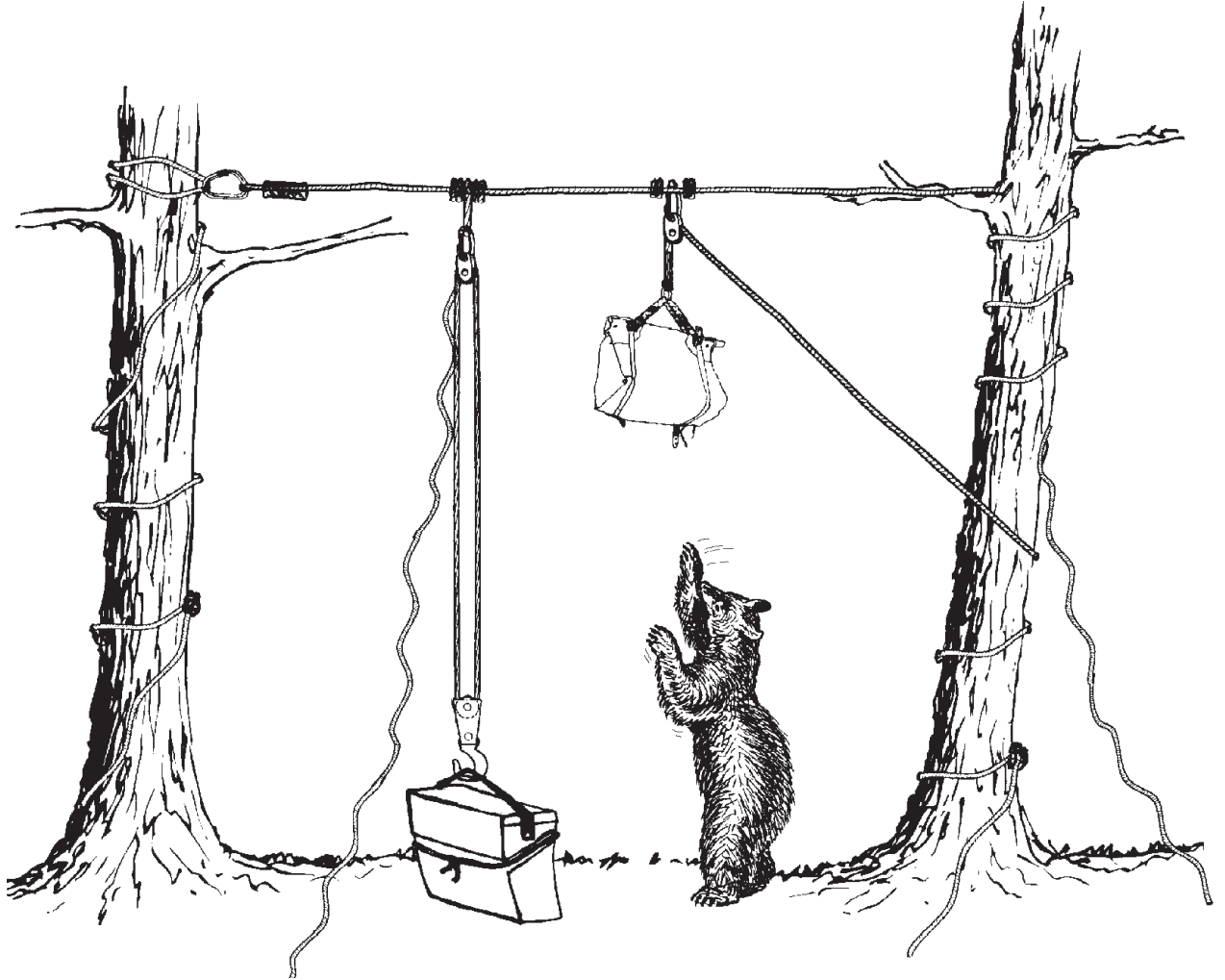
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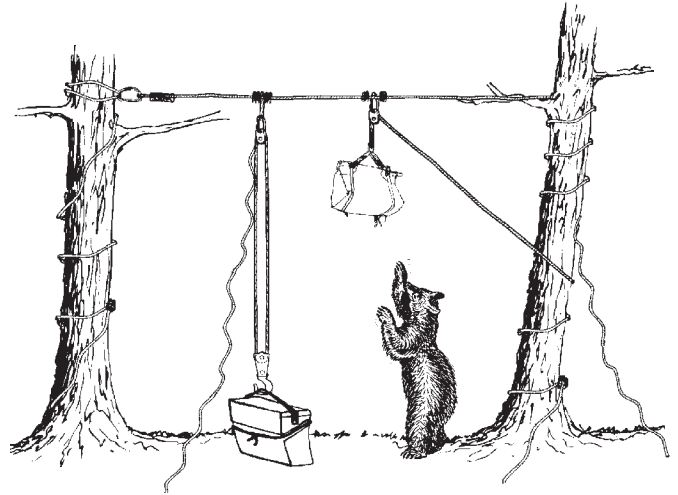
2300-Recreation
November 1994
Reissued April 1996
9523-2809P-MTDC
FS-587



Low-Impact Food Hoists



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XE52A57
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Grub and Grizzlies



Minimizing contacts between grizzly bears and humans has become an important focus of compliance with the Endangered Species Act in critical grizzly bear habitat. Agencies have proposed or implemented special regulations in many areas that require human and livestock foods and attractants to be stored so they are inaccessible to bears. Bear-resistant containers, hard-sided vehicles, and food suspended out of reach are all acceptable techniques.

Low-impact hoisting techniques are a reasonable alternative where permanent structures are not desired or available, particularly in wilderness. They eliminate the expense and weight of bear-resistant containers and are suitable when the loads are not extremely heavy.

This report describes techniques to hoist food—both human and stock—at least 10 feet high and 4 feet away from the supporting tree.

- No permanent installations or structures are needed.
- Hoists can be set up for the duration of the visit and be completely removed when it is time to strike camp.
- Climbing trees is not necessary.
- These procedures are affordable and practical and use readily available equipment.
- All of these techniques need trees for support.



There are some very real limitations to these low-impact hoisting techniques. Because of the variable strength of native poles, tree branches, rope and hardware, the amount of weight that can be suspended safely is not much over 125 pounds for the sturdiest system. It is not possible to accurately establish design strength of these systems since all the key variables are not known. Use common sense to identify the weakest link in the system you choose and do not exceed that capacity.

Be careful when working on or around hoists:

Do not stand under suspended loads.

Work on the opposite side of the tree from suspended cross poles.

Use care when raising and lowering loads to prevent injury to your hands, arms, head, or back.

Ropes, Cables, and Knots



Ropes: Figure 1 illustrates some of the ropes and cables you will need. Parachute cord, 1/8-inch-diameter nylon, is universally available, inexpensive, and lightweight. It is best used as the initial throw line to pull up heavier ropes and hardware. It also can function as a haul line to lift lightweight loads of 20 to 50 pounds.

Parachute cord stretches, which is a distinct disadvantage for a rope used in a hoisting system. A superior alternative to parachute cord is 1/8-inch braided Dacron, a strong cord that has less stretch than nylon parachute cord. It is available in mountaineering stores.

Manila rope (3/8-inch or 1/2-inch diameter), the traditional rope of choice for securing packhorse cargoes, is a good choice for any of the suspension systems, especially when it can double as a cargo rope. It is inexpensive, strong enough, and has limited stretch. It is not the most lightweight or strongest rope on the market.

Moving up in strength and price are a whole range of mountain-climbing ropes. Since full-strength climbing rope is very expensive and its strength is not needed for this application, smaller diameter versions, such as 5-mm climbing

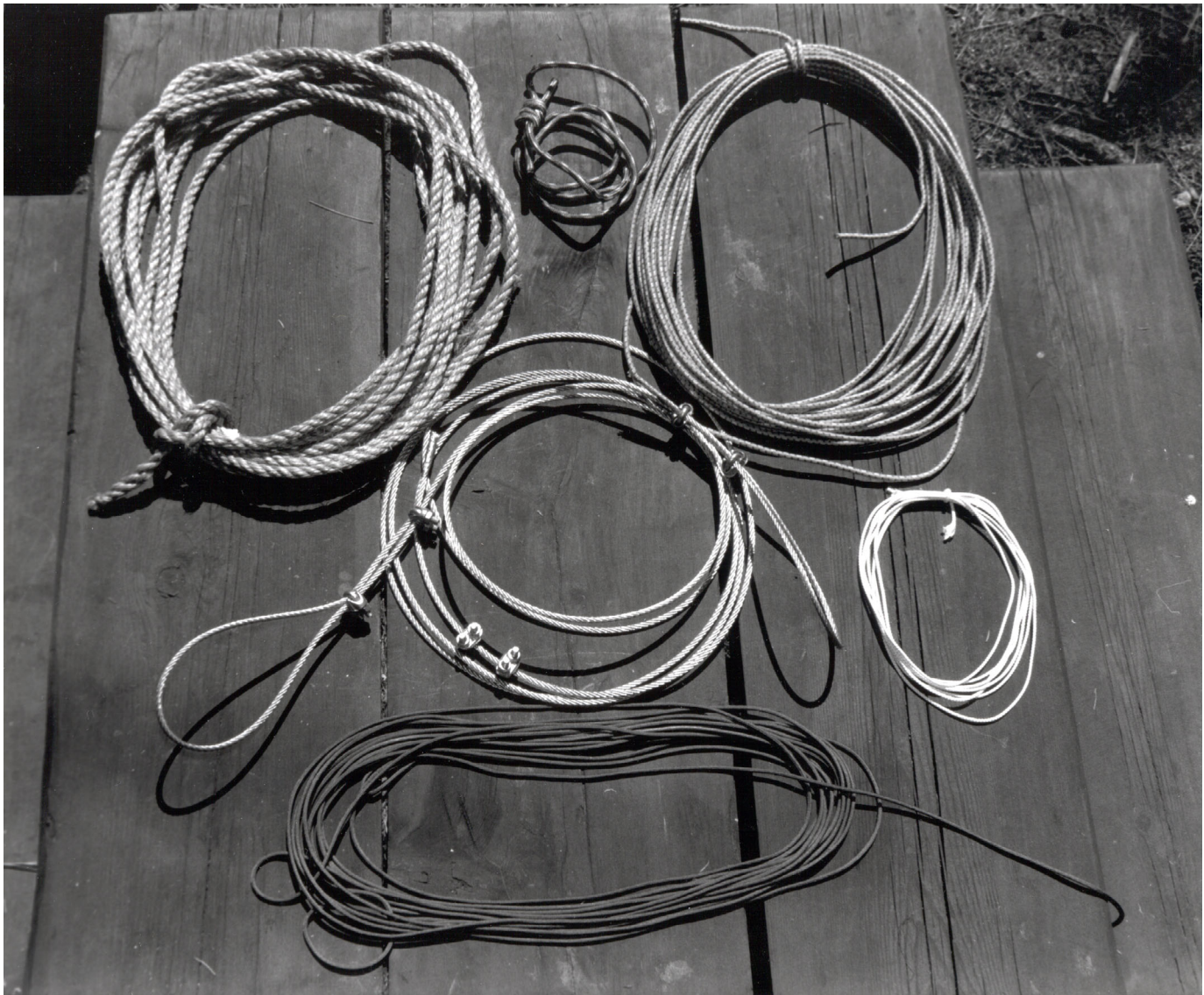


Figure 1.—Ropes and cables: 3/8-inch manila (upper left); 5-mm climbing accessory cord (upper middle and upper right); 3/16-inch wire rope (middle); 1/8-inch braided dacron (lower right); and parachute cord (bottom).



accessory cord, are excellent cost-effective alternatives. Sixty-foot lengths of 5-mm accessory cord worked extremely well in field tests of all of the techniques. The cord costs about \$0.25/foot. Match your rope with your pulley system.

There are many other ropes readily available that will work. A key factor for a hoisting system is to select a low-stretch or “static” rope. Many poly or nylon ropes stretch too much and are therefore not recommended.

Cable: Flexible steel cable, or wire rope (3/16-inch diameter, with a number of fine strands), is used in one method as a support cable between two trees. It is strong and will not stretch. Loops in the ends of the cable and slide arrester blocks need to be installed before heading for the field. Use double- and single-strand “micro-press” sleeves to create the loops and to serve as slide arresters if you are having loops and slide arresters made up for you. If you are making them yourself, regular bolt-on cable clamps work fine. Fasten the clamps as shown in Figure 2. Clamps will not hold on vinyl-covered wire rope.

Knots: Knots can make or break your hoist system, and their proper use is the mark of a professional. There are many knots to choose from, but here are a few favorites (Figure 3). A loop knot can create a loop anywhere in the line, useful for attaching a block directly to the rope without carabiners, or for attaching a fence stretcher or cable hook.

Another method for attaching a carabiner (Figure 4, left) or block to a rope is to first tie two ends of a short section of rope together with a double fisherman’s knot, creating a loop. Then attach the loop to the main line with a Prusik knot, which will move sideways with no load attached, but will not slip sideways under tension.

A knot hard to beat for creating a nonslip loop on the end of a rope is the bowline. A secure knot for attaching rope to a carabiner or block is a swivel hitch.

For more ideas, you may wish to refer to a knot instruction book such as *Bigon and Regazzoni*, 1982.

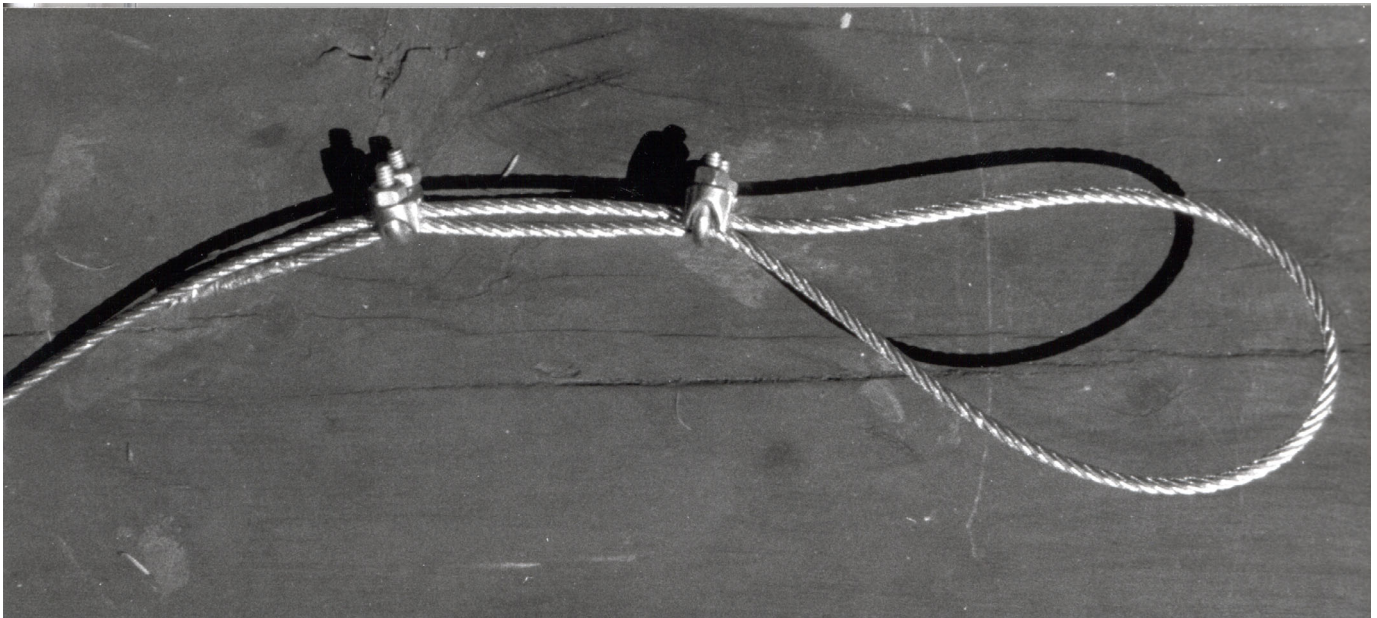
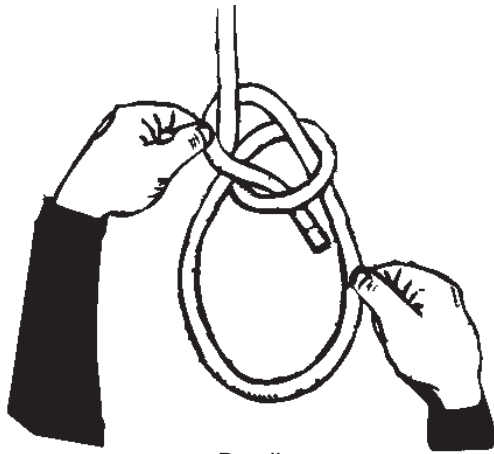
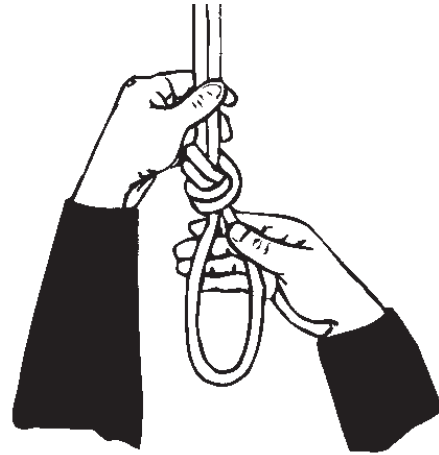


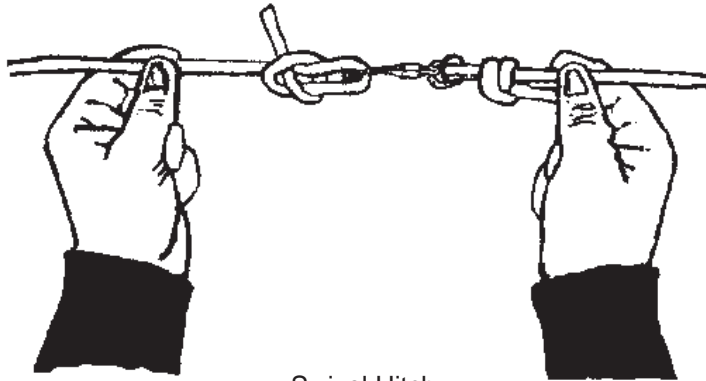
Figure 2.—Wire rope with clamps properly attached.



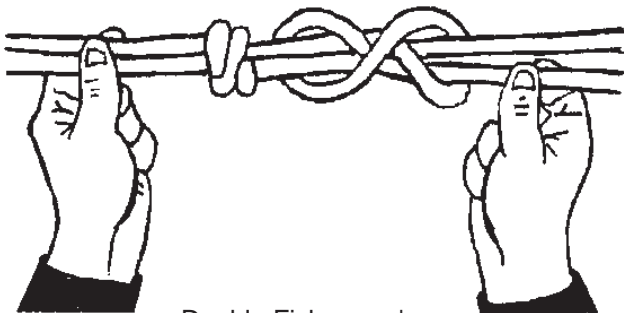
Bowline



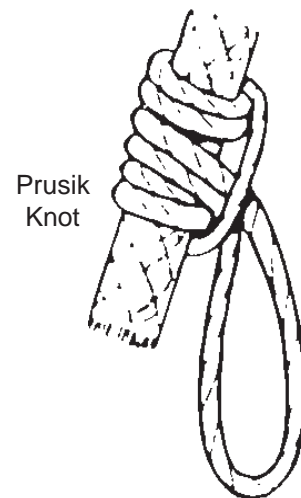
Loop Knot



Swivel Hitch



Double Fisherman's Knot



Prusik Knot

Figure 3.—Useful knots.

Hardware



If you've ever tried lifting a heavy weight into the air, you know that even with a pulley, and especially without, this job is not for weaklings. By applying some basic technology, you too can be strong enough to lift your food supplies out of the reach of grizzly bears.

Pulleys and Blocks: A pulley is a wheel with a grooved rim. A pulley mounted in a frame is called a block. A block containing a single pulley is called a single block; one with two pulleys a double block, and so forth. Two blocks properly threaded or "reeved" with rope are called a block and tackle.

Blocks are a basic component of most hoists. They are readily available at hardware, sporting goods, and mountain-climbing supply outlets. While top-of-the-line equipment is not usually needed, neither should you buy the cheapest

blocks you can find. Cheap equipment has broken under stress. Small, lightweight pulley blocks used for mountaineering and heavier steel blocks available at hardware stores are dependable choices and are available for under \$10 each (Figure 4). Carabiners (Figure 4, left) are the preferred means of attaching blocks to other lines and are available for a few dollars each at mountain-climbing supply outlets. In a pinch, a carabiner by itself can serve to reverse the direction of pull. Match your rope to the size of the pulley block used. More elaborate equipment, such as safety cams to prevent rope backsliding, and blocks, carabiners and ropes with extremely strong ratings, is also available. But, such equipment is expensive and much stronger than other components of these temporary systems, and therefore not needed for practical, affordable applications.



Figure 4.—Useful hardware for hoists.



Block and Tackle: A single block offers no mechanical advantage to the lifter. You end up lifting the entire weight, and just changing the direction of pull. However, by adding another block to this arrangement and creating a “single and single” block and tackle (Figure 5), you can reduce the force needed to lift a load by half. Adding another pulley increases your mechanical advantage to 3:1. Place the block with the most pulleys at the top, to serve as the immobile, or fixed block. This would enable you to lift a 100-pound load by applying 33 pounds of force. Blocks and tackle can be purchased in a wide variety of sizes and configurations, or you can make them up easily yourself from two blocks. Often one has a cargo hook attached to one end. A lightweight variation using 3/4-inch webbing and rollers instead of pulleys is also available for about \$20. It offers a 5:1 mechanical advantage and has an 800-pound capacity, but only 9 feet of lift with the length of webbing provided. (See page 14 for some sources.)

“Single and single” or “single and double” blocks and tackle should be adequate for most backcountry hoisting applications for up to 125 pounds or so. As more pulleys are added, the extra weight and length of rope needed may become a concern, even though making it possible to lift heavier loads. In field tests, a “single and single” block and tackle proved to be the least expensive, easiest to use, and overall best way to obtain mechanical advantage for weights up to 110 pounds.

Portable Pullers: There are many portable, compact pullers on the market. These devices (Figure 6) can be attached to the main haul line, tied off to a tree, and used to lift the load in the air. Some, such as a fence stretcher, can lift only a foot or two at a time. Others have 10-foot or longer cables. Most of these devices are too heavy (4 pounds for a fence stretcher, 6.5 pounds for one of the smallest pullers) for backpacking, but could be packed in a vehicle or on a pack animal. Tie off the haul rope before releasing the rope from the puller or fence stretcher. In limited field testing, portable pullers proved to be the least desirable way to obtain mechanical advantage. The 10-foot cable on the model tested was too short; the cable release mechanism was

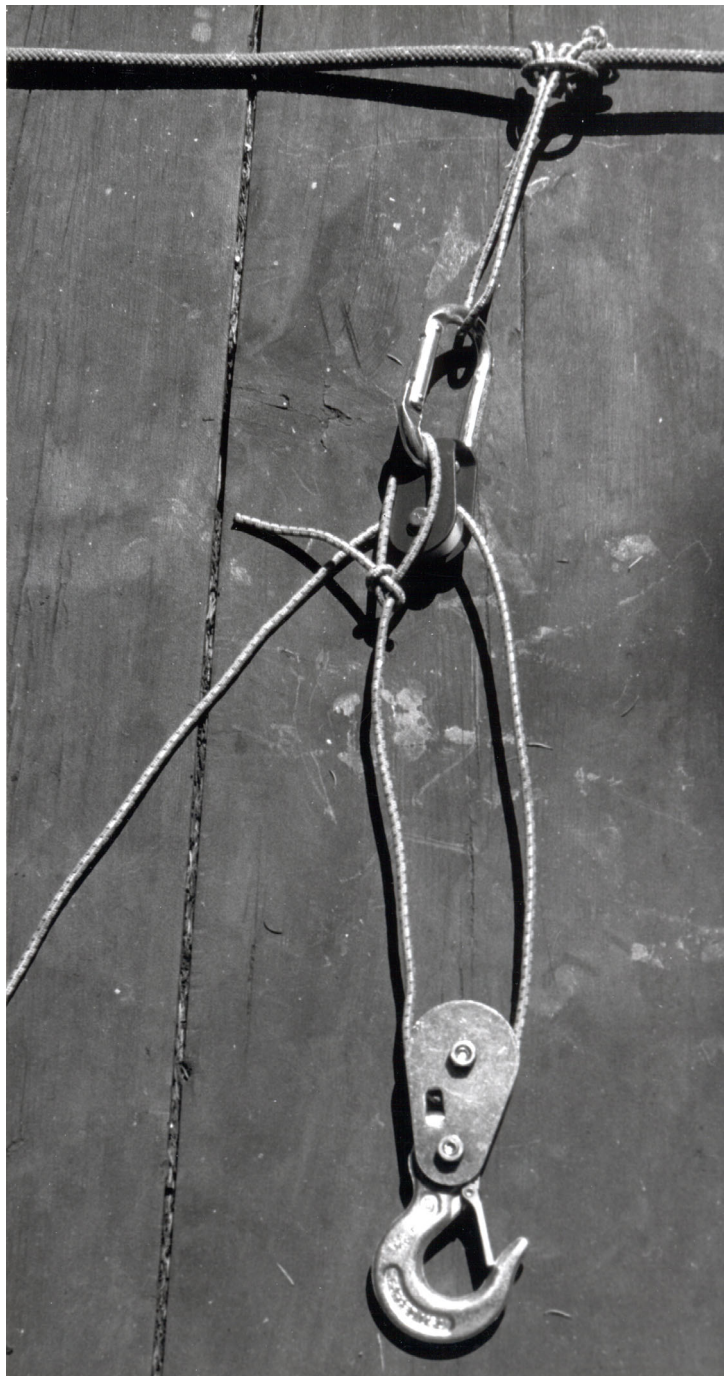


Figure 5.—“Single and single” block and tackle—recommended method for up to 110 pounds.



awkward and potentially finger-smashing, and lowering the load was extremely slow. Fence stretchers were not tested, but similar problems would be expected.

Winches: Compact hand winches (Figure 7), designed for all-terrain vehicles and snowmobiles, offer another possibility for attaching to your haul line. Tie off the winch to a tree. Depending on your system, use the cable or rope supplied with the winch as your main haul line or attach the cable to a nonslip loop in the haul line and tie off the haul rope to the tree before releasing it from the winch. The winch tested weighs 8 pounds. With a very low gear ratio (42:1 on the model tested), winches allow very heavy weights to be lifted with ease. At a cost of about \$100, specialty winches are the most expensive of the methods tested to obtain mechanical advantage.

Caution: Using any of these devices allows a person to lift heavy loads off the ground. Be sure the rest of your suspension system can handle the weight and give some advance thought to how to safely lower the weight once it is suspended. Do not allow the haul line to get wrapped around your hands, or legs, or nearby fallen tree limbs. Use a partial wrap around the tree if necessary to provide friction to the haul rope when lowering a suspended load. ***Wear gloves to prevent rope burn!***

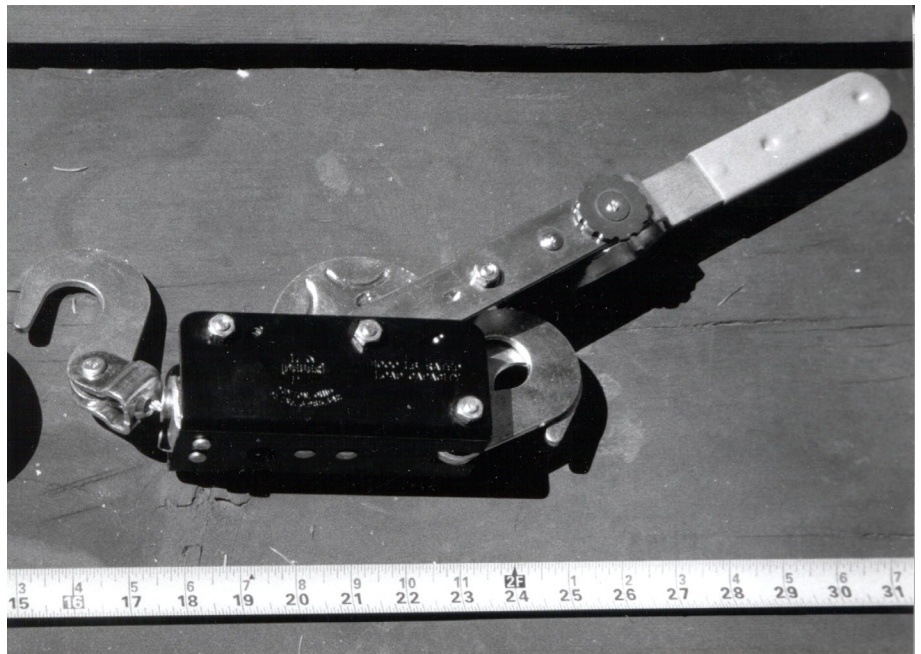


Figure 6.—Portable hoist/puller did not work well in field tests.

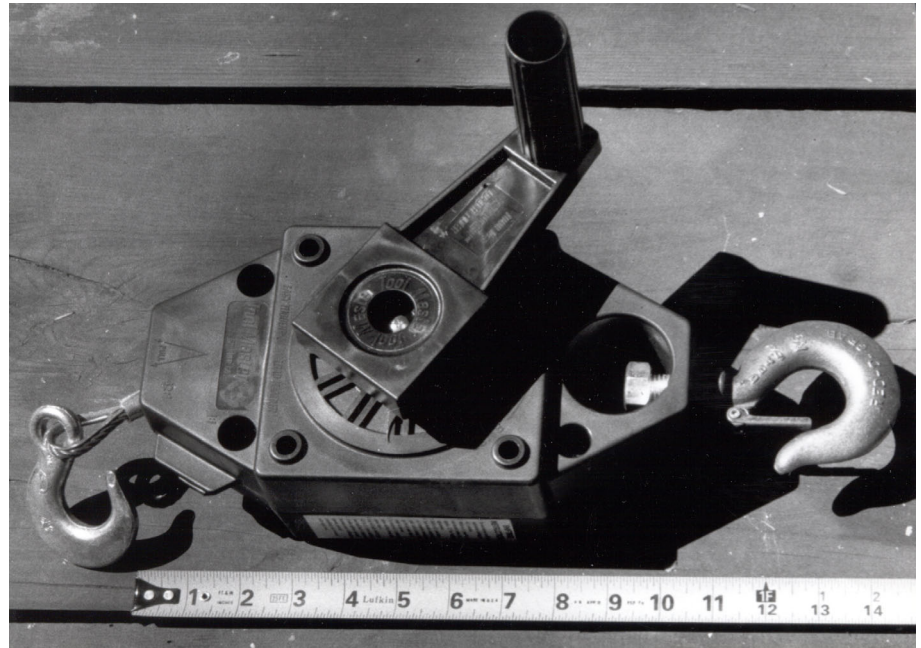


Figure 7.—Compact hand winch.

Single-Tree Techniques



The simplest way to suspend your food is to throw a rope or cord over a stout limb 15 to 20 feet high and at least 4 feet out from the tree trunk. Tie your backpack or food sack to one end, and haul away. Getting the rope over the tree limb is not always easy. Parachute cord or braided Dacron, used by itself or tied to a larger diameter haul rope, is easy to throw when a rock in a sock or mesh bag is tied to the end. **Be careful that the rock does not hit someone!**

This technique is suitable for lightweight loads, 20 to 50 pounds. Minimal equipment is needed. Hauling the rope is tough on hands, especially if just parachute cord is used. **Wear gloves!** The abrasion from some ropes also damages tree limbs. This method offers no mechanical advantage, and the friction of pulling the rope over the limb makes it 30 to 50 percent more difficult to lift the load.

It is often difficult to find a tree with a stout enough limb to support the load, especially in lodgepole pine country. If the load ends up closer than 4 feet to the tree trunk, try attaching a second cord to the load and throwing the other end over a limb in a nearby tree, which is then used to pull the suspended load at least 4 feet away from the tree trunk (Figure 8).

All ropes should be tied off to trees as high as possible, at least at eye level, to keep bears, other animals, and humans from getting tangled.

Adding A Single Pulley Block

Adding a single pulley block to the single-tree system makes a big difference in the ease of lifting loads because the friction of pulling over tree branches is reduced and abrasion damage to branches is eliminated. More weight, 50 to 100 pounds, can be lifted, depending on the strength of the branch, the hardware used, and the person doing the lifting.

To use this technique (Figure 9), first throw a light line over the tree branch, as described previously. Tie your light line to a strong support line with a block attached to the end. Thread a separate load haul line through the pulley. Pull the support line, with load haul line attached, up to the branch, and tie it off to the tree trunk. Attach your load to one end of the haul line and pull the other end to lift it into the air. Tie this rope off to a tree to keep the load suspended.

Again, finding the right tree with a stout enough branch is often a problem. Another weak link in this system is not having the pulley securely fastened to the tree branch, but rather draped over it and tied off to the trunk. No mechanical advantage is provided with a single block, but it is possible to add any of the devices described earlier to the haul line to provide mechanical advantage.

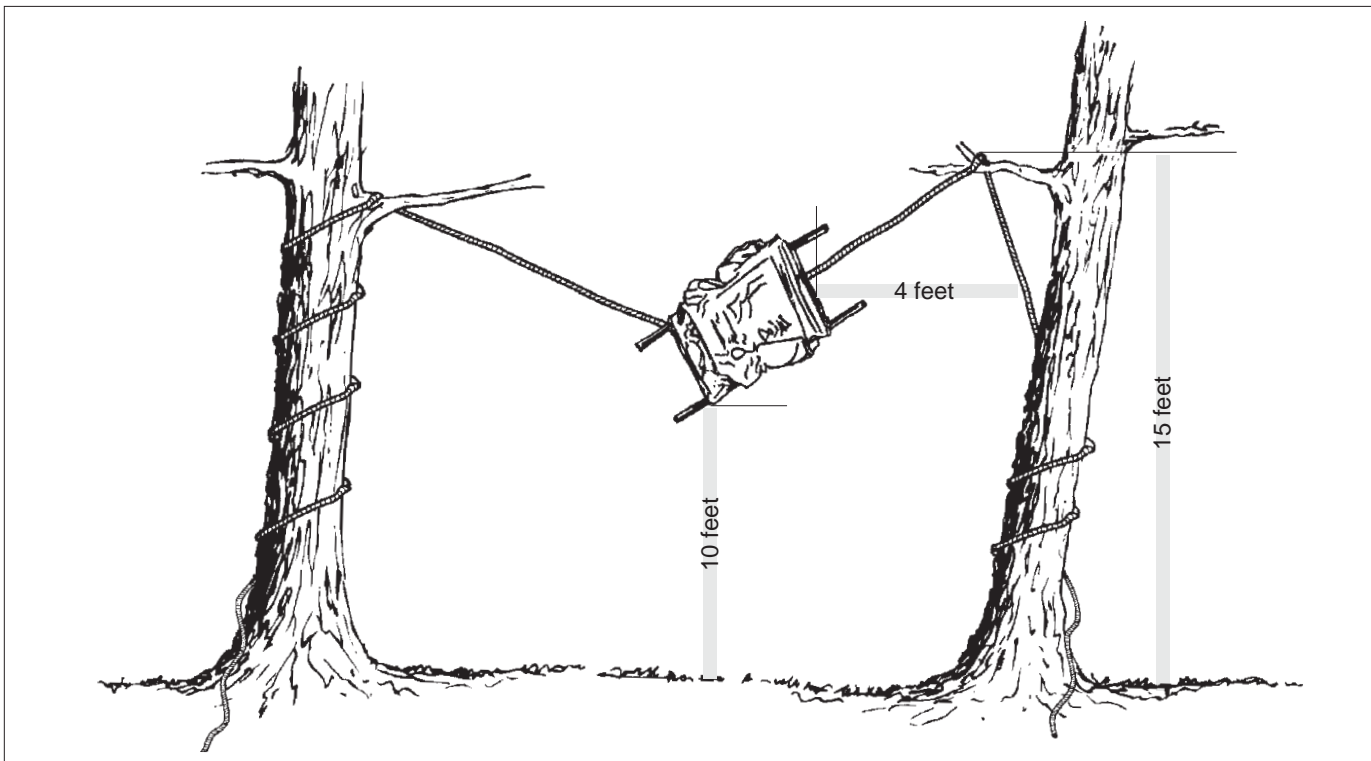


Figure 8.—Single-tree system with side pull.

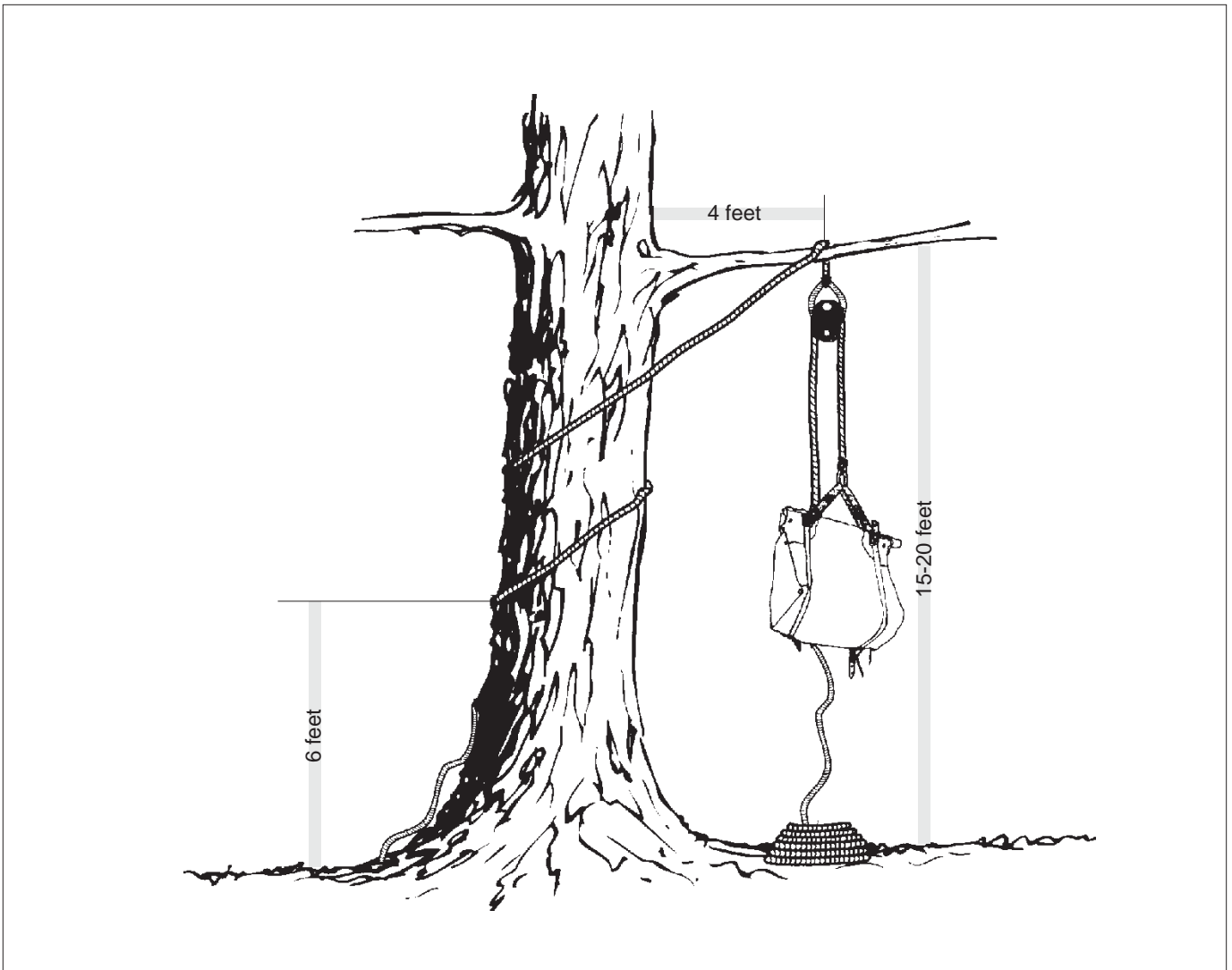


Figure 9.—Single-tree system with block.

Two-Tree Systems



There are several hoisting systems that suspend loads between two trees instead of from a single tree. Often suitable single trees are not easily found, and with two trees potentially more weight can be lifted.

The simplest two-tree method is to throw each end of a rope or cord over two limbs, tie off one end to the tree, attach a light load in the middle, and haul back on the other end of the rope until the load is suspended (Figure 10). Be sure to throw the rope over limbs as high as possible, since there will be considerable sag to the line and it may be difficult to lift the load high enough. Depending on the amount of weight being lifted, various types of rope can be used. Parachute cord may work for very light loads, but it is tough on hands because of its small diameter and tendency to stretch. Manila rope and mountain-climbing accessory cords are good choices.

All that is needed for this basic method is rope. Because there is no mechanical advantage and because of friction, load lifting is difficult. It is best suited for light loads, 20 to 50 pounds.

A variation on this technique increases load-lifting capacity. Throwing one end of the rope over a limb and tying it off as previously described. Instead of throwing the other end over a limb in a different tree, drape a pulley block over the limb of the second tree as described for the single-tree method, with the main haul line threaded through it (Figure 11). Attach the load to the main haul line and pull the end of that line to lift the load. Tie off to the tree. The weak link in this system is the pulley draped over the limb. But, since the block is close to the tree trunk the branch is stronger there than 4 feet out as required for the single-tree method described earlier.

When mechanical advantage hardware is used with this technique, use strong, nonstretch rope and quality blocks and other equipment. Also, the two trees should be at least 10 inches in diameter to prevent them from pulling together.

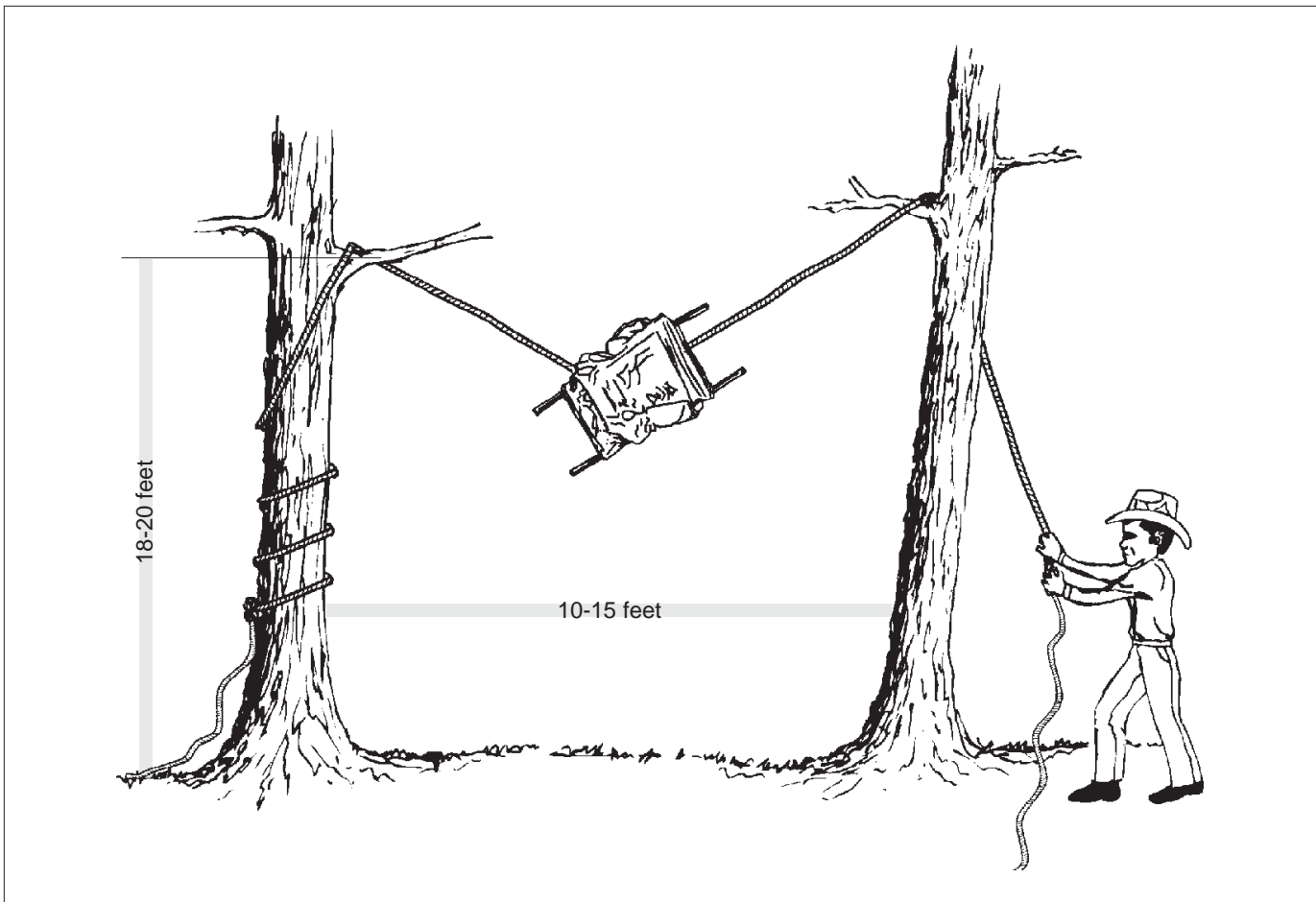


Figure 10.—Basic two-tree method.



Suspending a Support Pole or Cable Between Two Trees

The most popular and time-tested technique for heavier loads involves suspending them from a pole between two trees (Figure 12). Many of the permanently installed hoists utilize this technique, and heavy poles mounted with steel J-hooks and bolts can support an entire elk carcass. However, the low-impact techniques described in this report should not be used for such heavy loads because the support poles are not as securely mounted and the diameter of the poles is less than those typically used for the permanent installations.

Most popular is suspending a pole about 15 to 18 feet high between two trees. Getting the pole that high in the air without climbing the tree has left many people scratching their heads. One way is to place one end of a 15- to 20-foot pole, which should be at least 6 inches in diameter, in the crotch of one tree, then raising the other end using a rope and pulley draped over a limb in the other tree. Once the pole is raised to the desired height, securely tie off the lift rope around the tree. For added safety, throw some additional rope around the pole to help secure it to the tree. Lift the load by means of a second haul line thrown over the pole, or through preattached pulley systems. Winches, fence stretchers, or portable pullers can also be used to help raise the load.

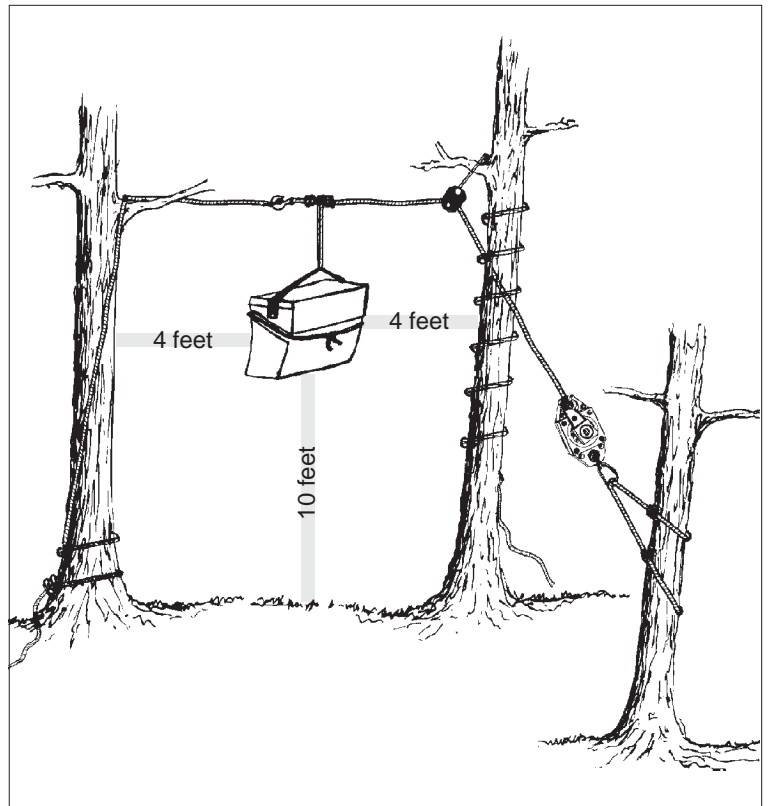


Figure 11.—Two-tree system with block.

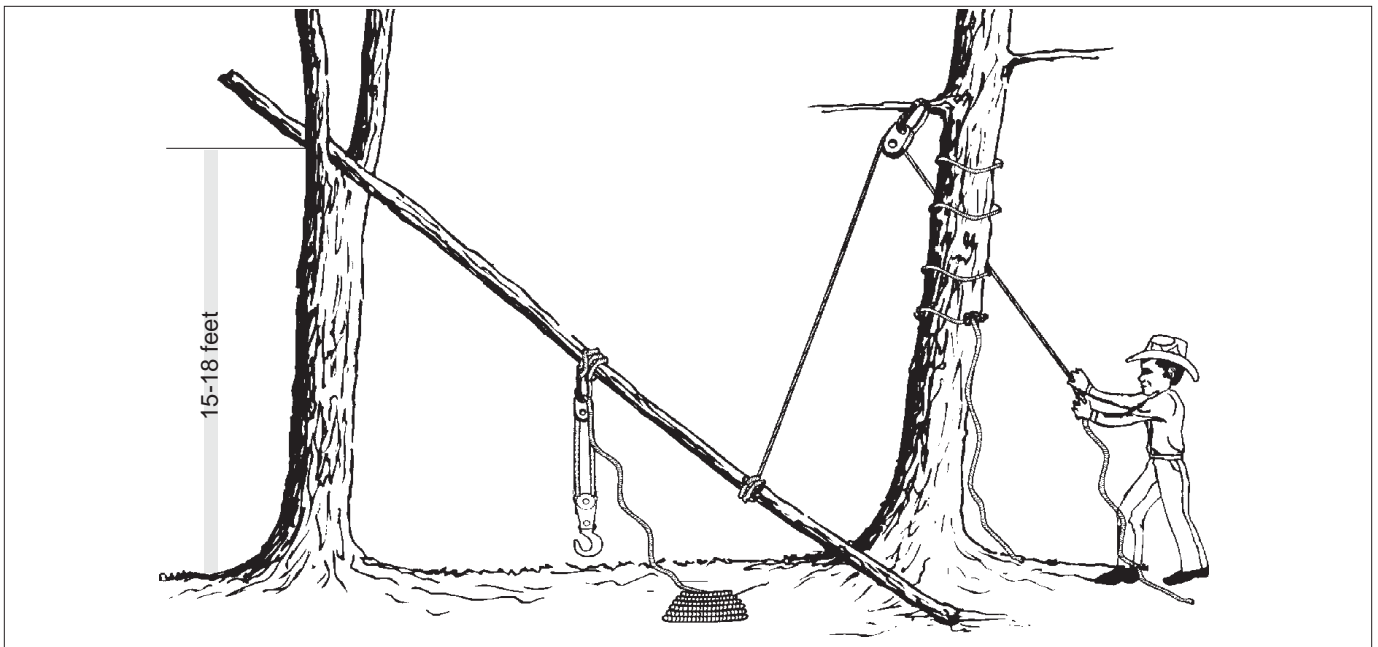


Figure 12.—Lifting a support pole.



A second, more secure way to raise the support pole is to first place one end in a crotch as just described. Then lash a second pole, 15 to 20 feet long, to the cross pole at a right angle (Figure 13). Carefully raise this structure against the second tree, like half of a football goal post, tying the vertical pole off securely to the second tree. Lifting all this weight may be difficult, so two or more people, or assistance from a block and tackle will help. Don't let the end of the pole in the tree crotch fall out. Erecting three poles, like an entire football goal post, is another possibility if the team is there to help lift it into place.

What should you do if there are no suitable poles handy or no crocheted trees near your campsite? Here, stringing a rope or cable between two trees, with a second haul line attached, works very well (Figure 14). People who have used this technique have found that the support line stretches and sags, so attach the rope extra high, 18 to 25 feet. Also, the support cable with load attached tends to pull the two trees together, so the trees should be at least 10 inches in diameter. Heavy loads can be lifted with this method.

Some sag in the rope is beneficial. The greater the angle of deflection or "sag" in the line, the greater the load capacity. Let's use 5-mm accessory cord with a breaking strength of 5.0 kN (1,124 pounds) as an example. If the distance between trees is 15 feet and only 1/2-foot of sag, the line will only support 150 pounds. With 1 foot of sag, capacity increases to 300 pounds, and 2 feet of sag increases the breaking strength of the support rope to 600 pounds. Table 1 illustrates load capacities with other variables.

Rope used as a support line should have limited stretch. Five-mm climbing accessory cord and manila packstock lash rope are good choices. Another option is a 15-foot length of 3/16-inch flexible 3x19 strand core wire rope with looped ends and cable clamps to stop sliding. Tie ropes to each end of the cable and tie off around the trees.

To install, first throw the rope over limbs on each tree, 18 to 25 feet high. Pull the heavier support line, with separate block and tackle attach as desired, into the air. Tie off one end of the line and hand-tighten the other end before tying it off.

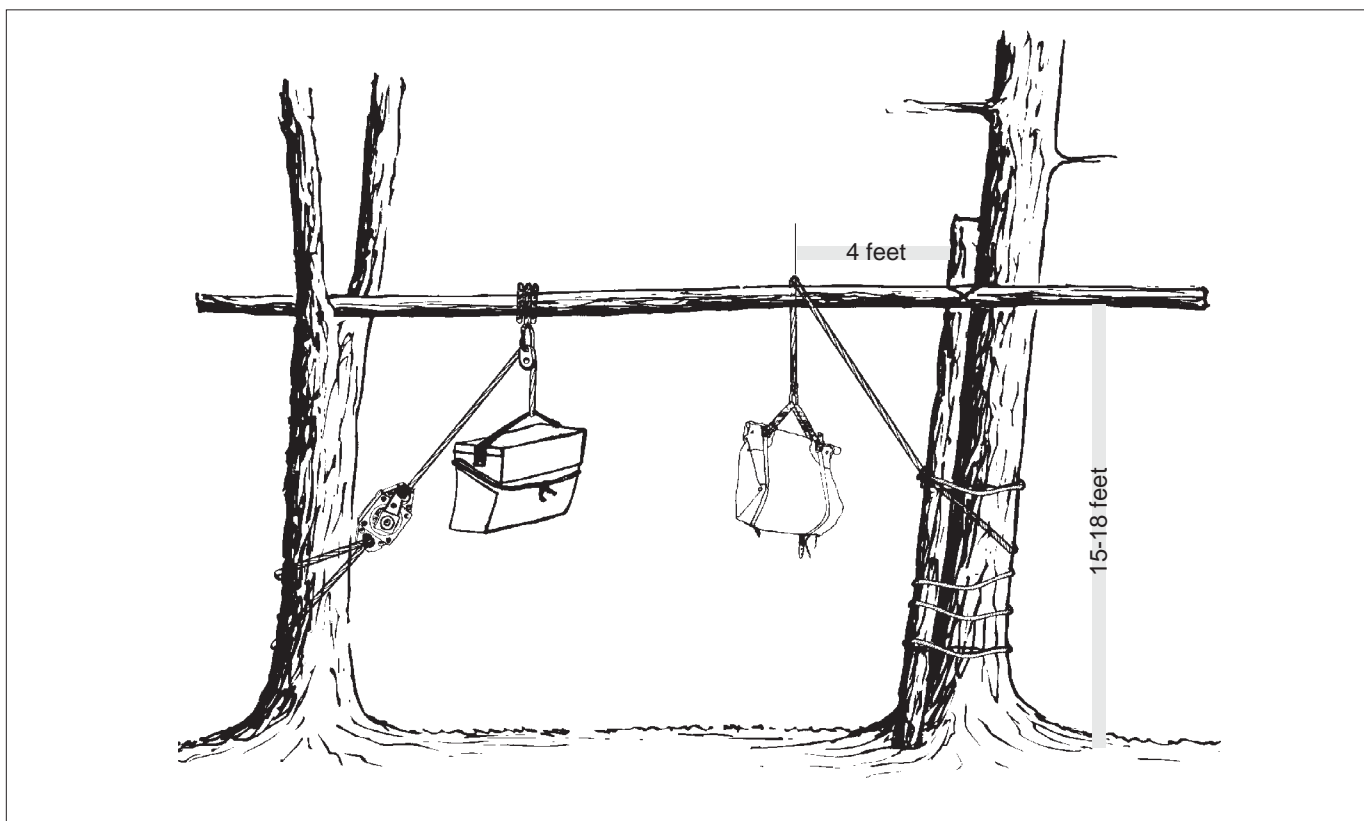


Figure 13.—Supported cross member.

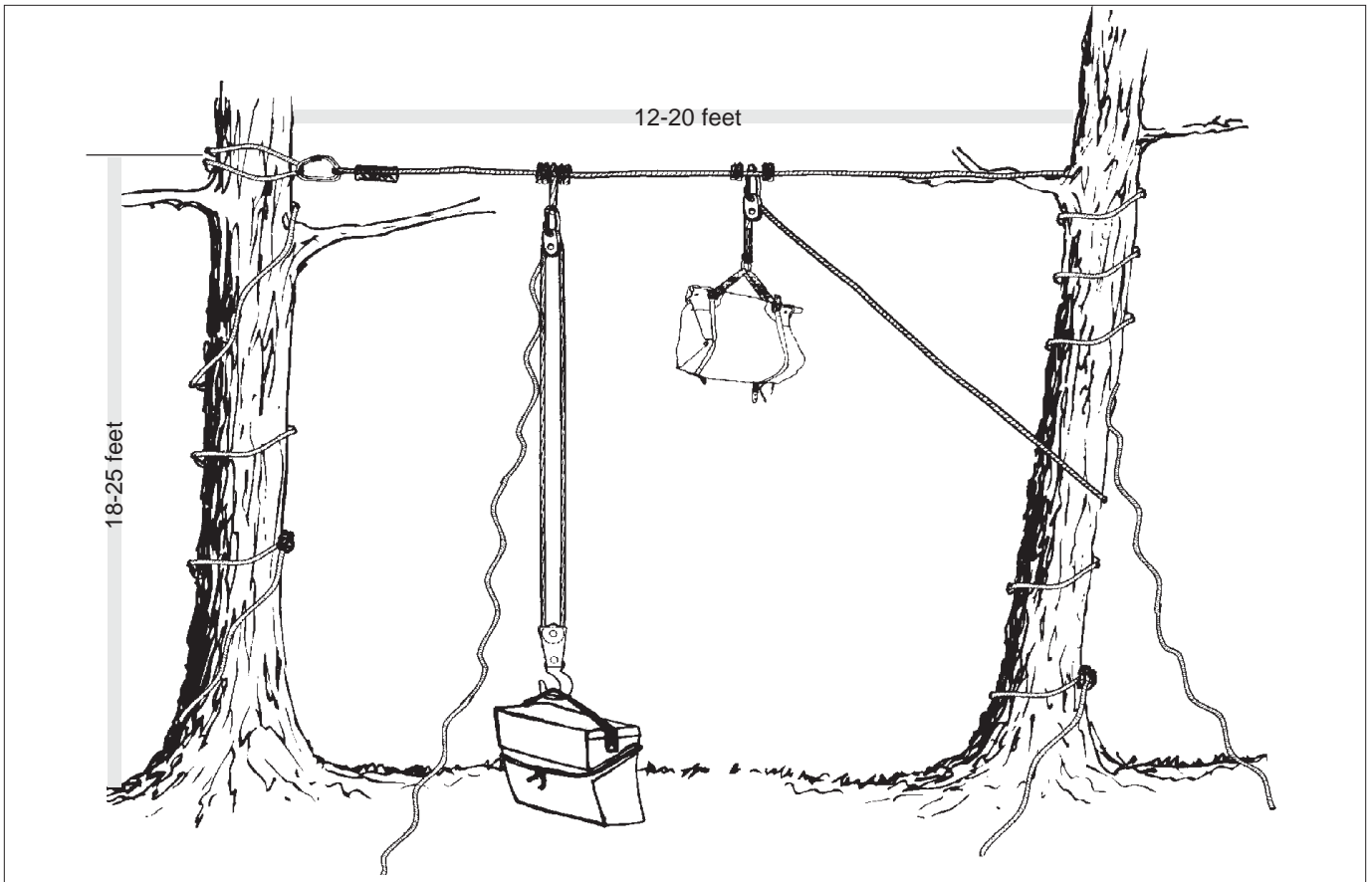


Figure 14.—Cable between two trees. This method also works well with accessory cord instead of cable.

Table 1.—Load capacity of 5-mm climbing accessory cord.

Deflection in Feet at Mid-Span	Distance Between Trees					
	5 Feet	10 Feet	15 Feet	20 Feet	25 Feet	30 Feet
0.5	450.3	224.9	149.9	112.4	89.9	74.9
1	905.2	450.3	300.0	224.9	179.9	149.9
1.5	1368.7	676.9	450.3	337.5	269.9	224.9
2	1844.8	905.2	601.2	450.3	360.1	300.0
2.5	2335.8	1135.6	752.8	563.5	450.3	375.1
3	2841.5	1368.7	905.2	676.9	540.8	450.3

Alternatives



Many users have found temporary hoisting systems such as those described in this report inadequate: suitable trees are not available, the systems take too long to set up, and lifting heavy objects into the air is inherently dangerous. Instead, they have selected alternative means to separate food from grizzly bears. What is permissible differs by jurisdiction, and whether wilderness is involved. Some agencies have installed permanent cross poles or other structures with and without winching systems;

provided permanent bear-resistant food storage boxes at campsites; or encouraged the use of portable bear-resistant panniers and backpack containers. For information on these alternative techniques, see sources listed below.

Another good alternative for hunters is to arrange ahead for prompt transport of game carcasses from the site of kill directly to a food locker in town, which eliminates the need to have the carcasses in camp at all.



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