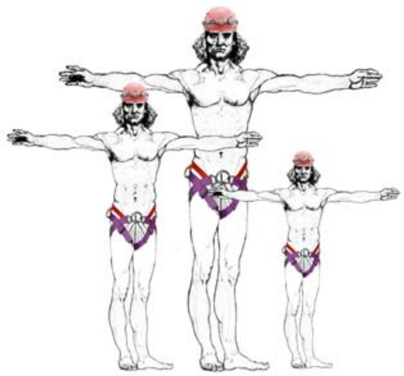
Typecasting The Vertical Caver

By John Woods   NSS # 10503



My curiosity about how different body types affected the efficiency of a climbing system was sparked by watching students. Some struggled with the Frog Ascending system while others had little or no trouble using it. The more I watched, the more it became clear: The efficiency of the Frog System was significantly affected by a person's body type. I wondered if there was a point at which the system itself became detrimental to some cavers. It is important to remember that I am not writing about people who are out of shape or physically disadvantaged. These are merely people whose body type may not correspond with what is efficient for the Frog system.

I felt that body characteristics should be seriously considered in accessing personal vertical efficiency. Universal techniques are generally effective, but when a specific climbing system hinders individual efforts, it should be reconsidered in favor of a broader view of the effectiveness of the individual and subsequently of the caving group at large.

The most common justification for the Frog System is: *Use a standard system and everyone will be happy forever after.* A noble goal, but it denies the aphorism: "Foolish consistency is the hobgoblin of small minds." The key word here is "foolish." A "consistency above all" doctrine fosters the impression that an ascending method other than the Frog somehow subverts Alpine SRT technique and causes fires, floods, and disasters of biblical proportions. Personally, I doubt the competence of any caver who cannot master a second ascending system without forgetting the first.

Staunch proponents of any specific system cleverly address their favorite only within the context where it excels. Froggers cite crossing obstacles like rebelays or equipment simplicity as the highest priorities. They claim that other systems are "heavy," "slow to cross mid-rope obstacles," or "very slow on/off rope." Climbing efficiency is never mentioned since it does not suit their arguments. Of the 20 cavers that I polled (from the U.S. and abroad) who advocated that the Frog System was definitively superior, only 2 had ever actually *used* any other system. Eighteen of them formed their opinions without either testing or personal experience.

Ropewalker and Mitchell advocates (all U.S. cavers) stress climbing efficiency as the highest priority. They suggest that the Frog is not the most efficient system in this respect. They also claim that time lost in crossing rope obstacles is compensated for by faster climbing times and energy saved. They ignore versatility, weight and simplicity when it compromises their position. Out of the 20 U.S. cavers with strong “anti-Frog” opinions, 18 had previous experience with two or more systems including the Frog.

Unfortunately, none of the advocates paid more than cursory attention to the relationship of body characteristics to the effectiveness of a system and NONE had ever compared the effectiveness of systems when ALL aspects of ascending were considered. This prompted me to conduct two sets of tests:

1. **The Frog System body type tests.** This is an investigation of the Frog System’s relative effectiveness in real-world situations with different body types.

2. **Comparisons of the Frog and the Mitchell ascending systems for crossing common mid-rope obstacles.** I tested the overall vertical efficiency when using both the Frog and the Mitchell systems under common Alpine SRT rigging conditions.

The Frog System body type tests

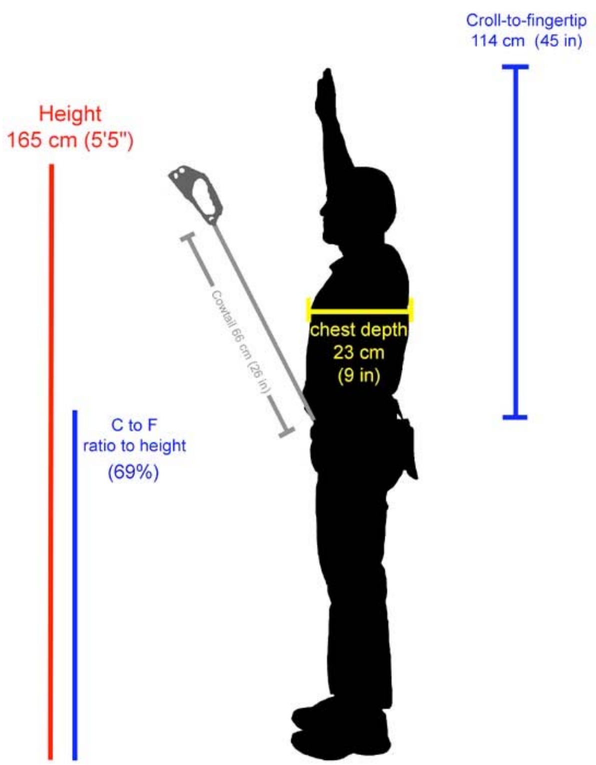


Fig 1: My actual body measurements. Overall height: 165 cm, Croll to Fingertip distance 114 cm (percentage to height - 69%), chest depth 23 cm, actual cowtail length 66 cm (without ascender). With a 35 cm (14 inch) stoke, my body type limits me to the low end of average for Frog System effectiveness.

The basic body characteristics affecting the Frog system are:

1. Overall height
2. Torso length
3. Arm and leg length
4. Chest depth: *To clarify: This is NOT a circumference measurement. It is the distance as measured straight through the body from the sternum to the backbone (see Fig. 1). A wide chest (left to right) does not necessarily indicate a deep chest*
5. Weight distribution top-to-bottom (top heavy or bottom heavy people).

I could find no published evaluations of how each body characteristic affected the Frog system. Not being an engineer, my best option was to test each effect on a practical level. Ten (10) different cavers were selected for body type testing. They represented a variety of body types ranging from short and stout to tall and lean. They comprised a reasonable cross section of cavers in the U.S., both in body type and degree of vertical experience.

Overall height: I'm a short guy at 1.65 meters (5'5") and my Frog vertical progress per stroke is only about 35 cm (14 inches). I measured the stroke of a very tall, long-limbed, narrow-chested caver (aka: "the perfect Frog body") and his bite was almost 63 cm (25 inches). This means that I must do 86 sit-stand cycles to ascend 30 meters (100 feet) while the taller caver does only 48 sit-stand cycles. When I mentioned this as a personal disadvantage to one Frog fanatic, he rashly declared that the total amount of energy required to climb a rope was ALWAYS the same for everyone. This is technically, but not effectively true because the efficiency of the climbing system has not been considered. Publications suggest that a properly adjusted Frog System should provide a stroke of approximately 25% of the caver's height. Because of the nature of the Frog System, this could only be literally true if everyone's body proportions were identical. By those calculations, my stroke should be approximately 40 cm (16 inches). Due to my body type however, my practical stroke limit is 35 cm.

Even if all body proportions were identical, this single assertion acknowledges that shorter cavers are inherently disadvantaged when using the Frog. I challenged the "perfect Frogger" to limit his stroke to equal mine and then tell me he used the same amount of energy to climb the rope as before. He wisely refused. He then countered with "But you have less mass to move each time!" The conversation ended when I replied "You have more muscle mass to move it!" It appears that even for advocates, the Frog is much less appealing with a 35 cm bite than a 63 cm bite. It would be equally inaccurate to state that long-limbed, broad-shouldered cavers can pass through small holes and tight "S" turns with the same amount of energy that I use. After all, it's the same horizontal distance isn't it? The lesson here is the imprudence of saying: "It works perfectly for me, so it must therefore be perfect for you!"

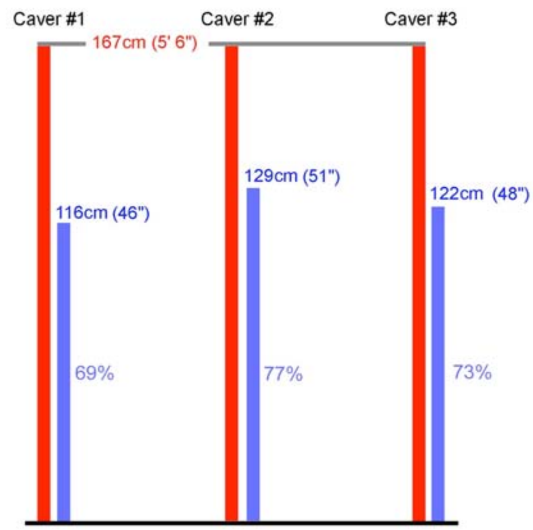


Fig 2: Combined torso and arm length varies between cavers of the same height. Red line = overall height, blue line = Croll to fingertip distance. Percentages are C to F distance to overall height. This affects the Frog "stoke" because it affects the length of the safety tether.

Torso length: A major consequence of torso length is that, when combined with arm length, it determines the maximum practical length of the Frog security tether attached to the upper ascender. This affects the maximum *Croll-to-upper ascender* distance and therefore the maximum potential bite. A tether longer than someone's reach is both pointless and problematic. Conversely, a tether that is too short limits the Frog stroke.

Torso length varied considerably between the people of similar heights who were tested. The worst case (shortest torso) lost bout 4 cm (2 in) on every stroke compared to a longer torso. This is an accumulating effect and is impossible to correct by altering the system in any safe way. Observations suggest that leg length is less important than torso/arm length to the amount of stroke because it does not affect the length of the safety tether that limits the stroke. Most Frog systems are initially adjusted to accommodate proper cowtail (safety tether) lengths and then the foot loops are adjusted in relation to the tether. The maximum stroke however, is still limited by tether length. More tests are needed to determine the precise effect of leg length on the Frog system, but I'm not sure how to conduct them.

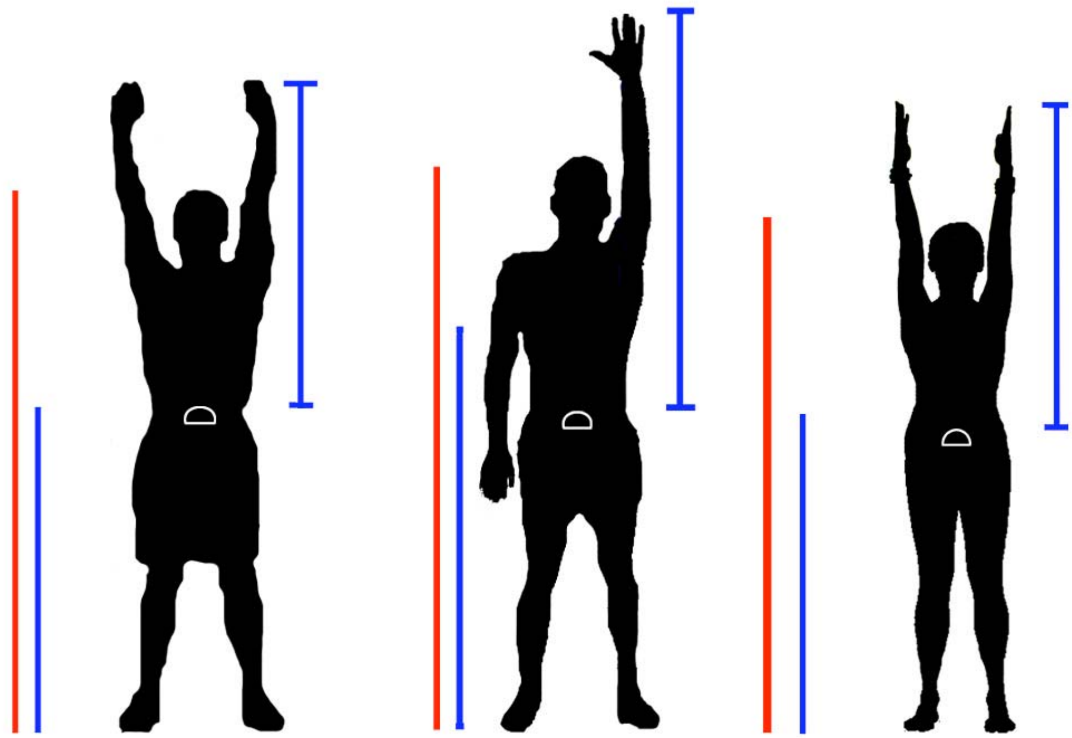


Fig 3: These silhouettes are made from photos and are proportionally accurate. The Maillon was added for clarity, but is located correctly for each person when standing. Measuring the Croll-to-fingertip distance on different cavers reveals the ratio of a caver's torso and arms to their height. The man in the center is not only 8 cm (3 in) taller than the man on the left; his Croll-to-fingertip distance is also a larger proportion of his height. Given equal body conditioning and skill levels, the Frog System is inherently most effective for the man in the center. The woman (right) is not only the shortest individual; she also has the lowest Croll-to-fingertip ratio. Her body type is the least effective of the three for the Frog System.

Arm length: Combined with torso length, the shortest torso and shortest arm combination that was tested showed a loss of about 10 cm (4 in) per cycle compared to people of similar overall height: 5 cm for the arms plus about 5 cm for the torso. The shortest torso and shortest arm proportion also happened to be on the shortest person overall: 160 cm (5' 3"). Their total stroke with the security tether length keeping the upper ascender within reach, was about 33 cm (13 in) per cycle.

Chest depth (front to back): I modified a Jumar ascender (see illustration) to measure how much relative load (pull) was being placed on it. Admittedly, the tests were not very precise, but I was after general load *differences*, not literal measurements. Climbing speed was not an issue and climbing times were not measured in this test. I instructed the climbers to use the best Frog technique possible and the climbing distance was kept short at 20 meters (65 feet), so fatigue would be a small factor. In reality, Frog climbing technique gets worse with longer ascents. Because literal arm loads varied with the climber, the distance and the individual climbing style, the results are expressed in percentages compared to the normal arm load of each subject.

The front-to-back chest depth was increased 4 cm (2 in) using a padded chest harness (See Fig. 5). The harness simulated the consistency and flexibility of the human body as closely as possible within my budgetary limitations. I then measured the arm load *difference* from each subject's norm without the vest. A two-inch increase in chest depth resulted in a *minimum* of 25% more load on the arms even with the best possible Frog technique. This 25% increase in load is not to be confused with 25% of the total body weight – it means that the individual climber placed 25 % more weight on the upper ascender than without the padded harness. Although the literal amount of pull varied with each person's technique, the percentage changes were fairly consistent in each individual as the chest depth increased.

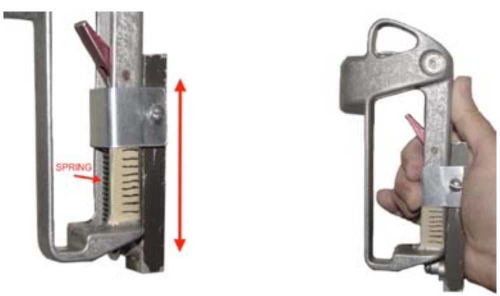


Fig 4: To measure arm load, I converted an old Jumar to a scale with a spring and a sliding hand grip. Load *differences* were recorded while climbing with the Frog and calibrated using a fishing scale. The ascender on the right shows a 500 g load.

Moving the upper body weight further away from the rope forced a significantly larger reliance on the arms to carry the load regardless of all attempts to remain vertical. It also forced the climber to thrust their head uncomfortably forward to maintain equilibrium. This makes it impossible for people with deeper chests to stay as vertical as people with narrower (front to back) chests. Due to fatigue, the arm load inevitably increased as the length of the climb increased.

Weight distribution (top to bottom): Since increased chest depth virtually always indicated greater upper body weight, the subjects were loaded up with chest weights equaling approximately 5% of their total body weight. The extra upper body weight forced the climber away from the vertical with every sit/stand cycle, subsequently forcing greater reliance on the arms to ascend. Increasing the chest depth 4 cm (2 in) AND chest weight 5% resulted in an arm load increase of about 33% (average) per sit/stand cycle compared to their norm.

Compounding the chest/weight problem

It is important to note that the above chest depth and chest weight tests measure only the arm load difference between each individual's normal technique and the modified chest test. Comparing the relative effort between climbers of different body types is even more revealing. My sampling included two subjects of approximately the same chest *circumference*, 104 cm and 106 cm (41 and 42 inches), and of approximately the same weight, 81 kg and 86kg (180 -190 lbs) respectively. The first subject however, was barrel-chested and the other had a relatively broad (wide), but not a deep chest. Despite the similar chest circumference and relatively equal weight, the barrel-chested subject routinely loaded the upper ascender with 10-12% more weight than the wide-chested subject. If equal strength and stamina are assumed for all subjects, the barrel–chested caver is at considerable disadvantage compared to the "average" caver.

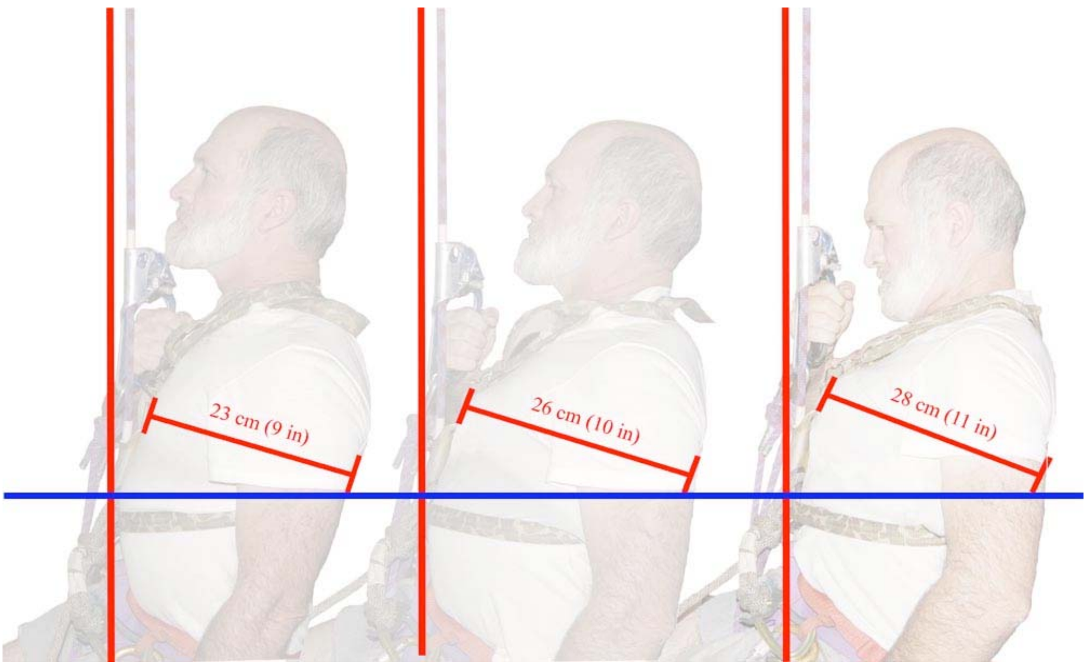


Fig 5: Relative body positions while on rope with increased chest depth. The vertical red lines are a true vertical reference, the blue line a true horizontal reference. Numbers indicate effective chest depth. The climber is grayed out to show measurements more clearly. The padded chest harness is worn underneath the shirt and is slightly visible. The left photo is without chest harness (normal). The center photo shows a 2 cm (1 in) increase. The right photo shows a 4 cm (2 in) increase. In each case, an effort was made to remain as vertical as possible. Note the changing head positions in each photo as the climber involuntarily adjusts to being thrown off the vertical. The 2 inch increase forced climbers into uncomfortable head positions to maintain proper equilibrium and verticality.

Body type test conclusions

Although I do not consider these tests definitive, they do provide insight into how body type affects the Frog system. The results suggest that with the Frog System, the amount of wasted energy significantly increases for some body types compared to others. The negative effects of greater chest depth, greater upper body weight, short stature, short arms and short torsos are cumulative and negative. They result in progressive inefficiency as the number of sit/stand cycles increases and fatigue sets in. Every time the climber is forced to compensate for being thrown off vertical or is required to use more sit stand cycles, energy is expended that the ideal Frog body type does not expend. The degree of efficiency varies with each climber, but the cumulative, negative effects cannot be denied. These factors indicate that for some climbers, there may be a point where the Frog system cannot be justified due to the body type. This suggests a need for an alternate ascending system that combines the versatility of the Frog under Alpine SRT rigging conditions, with greater climbing efficiency for those body types.

Europeans have recognized this systemic problem and some are addressing it through the addition of a low-placed foot ascender such as a Petzl Pantin for longer climbs. Current publications have suggested that the Pantin may be used to create a semi-ropewalker system. I have even found a couple of British websites illustrating a method of converting a Frog System to a bungee-assisted ropewalking system for very long ascents.

For many body types, the Frog System offers adequate climbing efficiency combined with minimal equipment and high versatility. Due primarily to its universality, most cavers should consider another ascending system ONLY if the caving situation warrants it, such as for extremely deep pits. However, with body types where the Frog System is significantly less effective, switching to an alternate system could improve overall personal vertical efficiency in nearly every situation. This would also improve group efficiency whenever that caver is present. The amount of individual improvement would depend upon the alternative system, the number of mid-rope obstacles (rebelays. knots etc.) and the length and spacing of the pitches.

The primary argument against using any system other than the Frog for Alpine SRT is that no other system can efficiently negotiate the rope obstacles found in expedition (universal) style rigging. Part 2 of this article compares the actual performance of both the Mitchell and Frog systems under standard Alpine SRT rigging.