Comparisons of the Frog and the Mitchell
ascending systems for crossing common mid-rope obstacles

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I am a staunch advocate of protecting the climbing rope. I favor the intelligent use of rebelays, deviations and Alpine SRT rigging where appropriate. Conversely, I think a *properly used* rope pad can fulfill all Alpine SRT safety concerns. When a pad is inappropriate, Alpine SRT methods offer an effective method of protecting the caver.

Cavers kept telling me that their particular system was better for this or that, but they always emphasized specific situations where their system was clearly superior and minimized situations where improvement was possible. I never heard an intelligent evaluation of OVERALL vertical effectiveness for an individual using a specific system. I quickly discovered that this was because no one (that I could find) had done the tests.

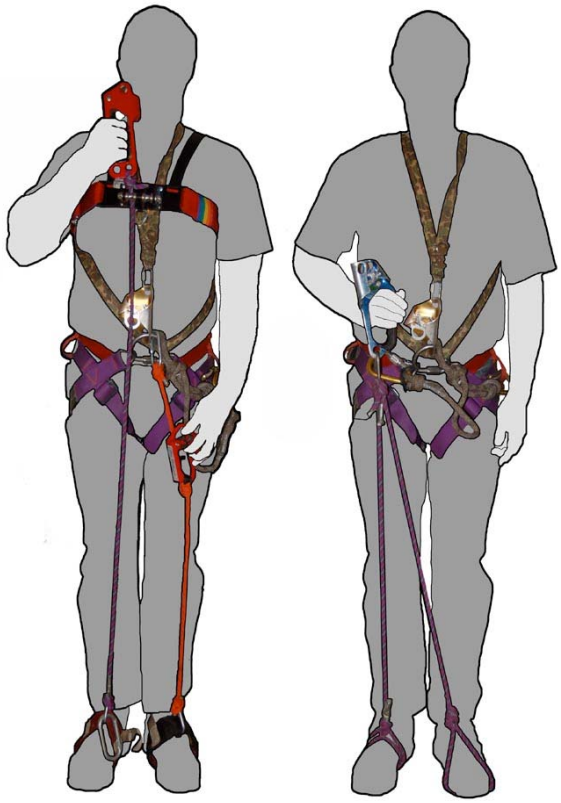

Fig 1: The Mitchell (left) and Frog Systems (right). Although the sit harness and cowtails are an integral part of the Frog system, they were not included in weight and bulk measurements. This Mitchell System includes a Croll and chest strap from the Frog System and a carabiner at the Mitchell System's right foot stirrup. These are used to convert the Mitchell to a Frog system when necessary.

I compared the Frog and the Mitchell systems: The former because it represents the world-wide standard and the latter because it was the "ropewalking" system that seemed most compatible with Alpine SRT rigging. Although the traditional American double-bungee ropewalker system is undoubtedly the most energy efficient method of climbing an unobstructed rope, it lacks the versatility of the Mitchell System for crossing obstacles and can be problematic in muddy situations. Aside from greater weight and bulk, the Ropewalker's low foot cam and bungee cords are considerable disadvantages at mid-rope obstacles. For these reasons, I felt that the Ropewalker could not be employed effectively with expedition-style Alpine SRT rigging.

Fifteen (15) different cavers took part in my tests and I took every test myself. The tests were conducted in several locations: my home, an outdoor climbing location near my home and at NSS Conventions. Rebelays, knot crossings and changeovers employed cavers who were very familiar with the system they used. This was to prevent needless fumbling that would skew data. These tests were not about ***learning*** a system, they were about ***using*** a system. In other tests, such as the free-fall climbing tests, and "gearing up and down" tests, all 15 cavers were tested. This provided relative speed and efficiency information as well as evaluations of the inherent difficulties in setting up and using each system at different experience levels. "Racing" was prohibited and realistic caving speeds were maintained.

General characteristics of the Mitchell and Frog Systems

The ***general advantages*** of each system:

1. The Frog System is lighter and more compact than the Mitchell. It is *slightly* faster than the Mitchell System (my opinion AFTER testing) for crossing certain mid-rope obstacles such as rebelays. It is also well-suited for multiple pitch caves where the pitches are relatively close together or relatively short (less than 40 meters). "Gearing up" and "gearing down" (travel readiness) times are minimal with the Frog. Its primary attributes are simplicity and high versatility, both in equipment and in method.

2. The Mitchell requires significantly less energy to ascend than the Frog. My tests indicate that it is a *minimum* of 25% faster for any body type when ascending unobstructed ropes. It is well-suited to situations when pitches are either relatively long (more than 40 meters) or spaced far apart. Its primary characteristics are high climbing efficiency for almost any body type and high versatility. With the addition of a Croll ascender and the elimination of the roller box, the Mitchell can be converted into a Frog system without other modifications.

The ***general disadvantages*** of each system:

1. The Frog requires more energy and/or more time to climb an unobstructed rope compared to the Mitchell. The longer the pitch, the less effective the Frog becomes. Tests indicate that certain body types are significantly less effective with the Frog system than others.

2. The Mitchell is heavier and bulkier than the Frog (see below for specifications). In addition to two ascenders with foot loops, it requires a double-roller chest box and harness. It takes *slightly* longer to cross certain mid-rope obstacles such as rebelays (see tests). It requires more "gearing up" and "gearing down" in order to travel. It is less suited than the Frog for closely-spaced multiple pitch situations or when pitches are generally short.

The goal of my testing was to determine how much these advantages or disadvantages actually affect the OVERALL vertical experience for both the individual AND the group. The main question is: Is one system definitively superior in terms of vertical effectiveness in real-world Alpine SRT situations?

Fig 2: My personal system components. Frog at left and the Mitchell system used for testing at right. Weight and bulk measurements did NOT include the sit harness and cowtails for either system. A dedicated safety tether (gray webbing) was included for the Frog. These systems are built to my specifications and both systems can be further minimized in both weight and bulk.

"Results at a Glance" from all tests may be found at the end of the test section

Comparative system weights

Weight of my *personal* **Mitchell** System shown above: **1470 grams (3.2 lbs)**.

This includes a Petzl Ascension handled ascender, a Petzl Basic (non-handled) ascender, a "Fritzke" double roller chest box, harness and foot loops. **A sit harness and cow tails were NOT included in the weight.** This is a *very* comfortable system. Its 2 inch sewn foot loops, well-padded padded chest harness, and other creature comforts increase both weight and bulk over a minimized Mitchell system.

With the lightest commercial chest box assembly ("Flash Box" plus harness), two Petzl "basic" ascenders and rope foot loops similar to the standard Frog foot loops, the weight of the Mitchell system can be decreased to about **1200 g**. This set-up can be considered the approximate minimum weight of a Mitchell System that does not compromise climbing efficiency (See Fig. 3b).

Approximate weight of light Mitchell System: **1200 grams (2.6 lbs)**.
Approximate weight of light **Frog** system: **870 grams (1.9 lbs).**

The light Frog System includes two ascenders, a Petzl Ascension and Petzl Croll, 1 long foot loop, a 1" "serpentine" chest harness. **Although required by the Frog system, the sit harness and cow tails were NOT included in the weight.**

With both systems optimized for minimum weight, there is approximately a **330 gram (.7 lbs)** difference between the Frog and the Mitchell systems. With more comfortable (and more common) Mitchell chest harnesses, sewn foot loops and larger chest boxes, the weight difference averages between **500** and **544 grams (approx. 1 lb)**. Personal comfort levels are highly individualistic and no attempt was made to access them. They are however, real-world concerns, particularly during long cave trips or on long pitches.

Note: European publications have indicated the increasing use of Petzl Pantin foot ascenders as standard equipment for longer pitches. Using the Pantin, Frog climbing technique can be modified (semi-ropewalker) to improve efficiency, but this system was not tested. A Pantin ascender adds approximately 80 grams (2 oz.) to the Frog System weight and approximately 30% to its bulk. The difference between the modified Frog and the lightest Mitchell system is approximately **250 grams (.5 lbs)**.

Comparative Systems bulk

This was somewhat difficult to measure, so I stuffed the system components tightly into a bag and measured the bag. Two ascenders are used for each system and the foot loop weight and bulk is approximately the same for both systems if rope foot loops are used for the Mitchell. Additional weight and bulk is mainly from the Mitchell roller box and chest harness. On average, the addition of the Mitchell system chest box and harness increases the total ascending system bulk about **50%** over the Standard Frog (see illustration). Actual bulk depends largely upon the chest harness and box that is used, so no definitive comparison is possible except in specific cases. The smallest Mitchell System has about **20%** more bulk than a Pantin-modified Frog System.

Fig 3a: The left bag (above) contains the complete expedition-style Mitchell System shown at right. The right bag contains my normal Frog System as shown above (no sit-harness, no Pantin). The Mitchell bag measures approx. 25 x 18 x 10 cm. (10 x 7 x 4 in). The Frog bag measures approximately 20 x 16 x 10 cm (8 x 6 x 4 in).

Fig 3b: This Mitchell has been reduced to minimum weight (1200 g) and bulk without reducing climbing efficiency. It uses 8 mm rope instead of sewn foot loops, a Flash Bar roller box and two Petzl Basics. The tan webbing (left) is the "chicken loop" loop for the upper ascender. The other ascender uses a sit-harness tether instead of a chicken loop.

Free climbing test (no mid-rope obstacles)

It should be remembered that the professed goal of Alpine SRT rigging is to eliminate ALL rope abrasion. The ultimate expression of this would be that ALL drops would be rigged as free drops, leaving only man-made rope obstacles (rebelays, deviations etc.) to be negotiated. This of course, is possible only in theory.

For straight free-fall rope climbing with no obstacles, the Mitchell was demonstrably superior to the Frog when the same climber used both systems. Even with minimal experience, Mitchell climbing speed was often more than 30% faster than the Frog. This was measured by total climbing time over the same distance at a moderate (cave worthy) pace with each system.

Participants climbed 20 meters (65 feet) with the Frog System first. There was a 45 minute rest period before the Mitchell system was used by the same test subject. The results were fairly consistent with the "worst" Frog body types (see body type tests) improving to the greatest degree. Heart rates were measured before and after the climbs to determine if the climbers were favoring one system over another. Heart rate increases were surprisingly similar at the end of each climb (for each individual climber), but overall times were a minimum of 25% faster (35% maximum) for the Mitchell.

Crossing rebelays

The ability to cross rebelays was one of the major factors cited as a significant advantage of the Frog system. After watching my friend Peter Jones negotiate a free-hanging rebelay in 30 seconds with his Mitchell system, I wondered how much of a practical issue it really was. I conducted two different tests.

Rebelay Test #1

The test rebelays were free hanging. They were crossed several times by several different cavers, all familiar with their chosen systems and with rebelays. Each caver was allowed to use whatever procedure they desired as long as it was safe (minimum two points of contact). The **first** test was timed from the point where the climber **clipped in** their safety cowtail to the rebelay loop or anchor (beginning the crossing) and the time that the safety cowtail was **removed**, ending the crossing.

The Frog System *averaged* about **15 seconds** to cross a simple rebelay with an experienced Frogger. The shortest crossing time was about 10 seconds. The Mitchell System averaged about **30 seconds** for an experienced Mitchell user. The shortest crossing time was 20 seconds.

In this test the Frog was measurably faster, but afterwards I realized that it was not necessarily indicative of overall efficiency for several reasons:

1. I wanted to measure the efficiency of the systems based on the TOTAL ascent time, including mid-rope obstacles. The first test measured only the rebelay crossing time.
2. When Frogging, the safety cowtail is usually removed once both ascenders have been relocated above the anchor, but BEFORE the climber begins climbing again. Efficient Mitchell technique makes it easier to actually ascend a couple of steps above the anchor BEFORE removing the safety cowtail. This places the climber higher on the rope when the cowtail is removed and some vertical progress has been made.
3. The two systems have a difference in their "re-start" efficiency AFTER the cowtail is unclipped and when climbing is resumed. Crossing a rebelay effectively means that the climber is starting over with no rope weight to assist them. Froggers cannot clamp the rope with their feet until they have progressed high enough in the rebelay loop to do so. They usually have to pull the rope through their lower ascender for two or three sit-stand cycles before they gain sufficient height to climb normally. This slowed their upward progress immediately after the rebelay. The Mitchell system however, functioned almost normally as soon as both ascenders had passed the rebelay anchor. This is because the cams can be manually thumbed open. The first test did not take this into account because the timing ended when the cowtail was removed.

Rebelay Test #2

I retimed the rebelay crossing starting from the same point as before, clipping in the cowtail, but ending it when the climber had ascended 3 meters (10 feet) ABOVE the rebelay anchor. This test was designed to include restart efficiency and any procedural differences for crossing rebelays.

The Frog system *averaged* about **30 seconds** to cross the rebelay and ascend 3 meters above the anchor. The Mitchell *averaged* about **40 seconds** to cross the rebelay and ascend the same distance above the anchor. There was no significant time expended to regain full ascending efficiency with the Mitchell, so there was only a 10 second difference when measured in this manner.

Rebelay conclusions: The Frog is certainly faster than the Mitchell on the rebelay itself. When measured as part of the practical, overall vertical progress however, the difference is slight. Unless there are numerous rebelays or the pitch is short (less than 10 meters), the faster climbing times of the Mitchell outweigh the time lost at any single rebelay.

Fig 4: A Frogger on our outdoor treadmill (left). Negotiating one of the practice rebelays (center) and a first-time Mitchell user on the treadmill (right). The treadmill was also used for knot crossings and deviation crossings.

Photos courtesy Ryan Baker and Rich Collier

Changeovers (ascent to descent)

All published tests involving rappels were conducted using a Petzl Stop descender.

The Frog averaged about **40 seconds** for an experienced user with descending equipment ready to attach to the sit harness. This means the rappel device was attached to a sit harness accessory loop and NOT buried in a cave pack. If the descender is already attached to the sit harness, changeover times decreased equally for both systems. Two points of rope contact were maintained at all times until the rappel began. This is the total time required to attach the descender, thread the main rope into the descender, lock off the descender, remove all ascending gear and unlock the descender for rappel.

The Mitchell averaged about **45 seconds** for an experienced user with descending equipment ready to attach. Two points of contact were maintained at all times until the rappel began. This is the total time to attach the descender, thread the main rope, lock off the descender, remove all ascending gear and unlock the descender for rappel.

Note: With both systems it can be significantly more difficult to changeover with racks than with capstan-type descenders such as the Petzl Classic. This not only due to the length of the rack, but also because racks load from the top down while the capstan type descenders load from the bottom up. The "bottom up" loading allows the capstan descenders to be drawn much closer to the lower ascender, reducing the amount of slack in the rope. With long (6-bar) racks, changeovers are slightly easier with the Mitchell system than with the Frog. This is because the lower Mitchell ascender can be raised to a point just below the chest box allowing the rack to be placed much higher on the rope than with the Frog system. Mini-racks are the less affected by system differences due to their shorter lengths. Either system can be effective with either rappel device, but the step-by-step changeover procedures are different.

Changeover (ascent to descent) conclusions: Although measurably different, there is little practical time difference between the Frog and the Mitchell system for doing ascent to descent changeovers. The type of descender used can dramatically affect both the time and effort required to do changeovers with either system.

Changeovers (descent to ascent)

For this test, all *ascending* gear was worn by the caver during the rappel.

The Frog System *averaged* about **40 seconds** to convert from descent to ascent. Most of this time was spent disconnecting the rappel device *and adjusting the tension of the Frog chest harness.*

The Mitchell *averaged* about **45 seconds** to convert from descent to ascent with the chest harness already on the caver. Most of this time was spent disconnecting the rappel device and connecting the chest box to the main rope. In practical caving, some Mitchell users do not wear their chest harness while rappelling. If the Mitchell chest harness is not worn, it would add considerable time **(about 1 _ minutes)** to put it on while on rope. Since a Mitchell system can be converted to an effective Frog system by wearing a Croll ascender when on rappel, the use of the Mitchell chest harness is not necessary for a safe descent. See my Mitchell-to-Frog Conversion article for details.

Changeover (descent to ascent) conclusions:

In this case the Frog system is generally easier to manipulate than the Mitchell because it has only two components. It is not significantly faster however. In real-world scenarios many Mitchell system users do not wear their chest harnesses while rappelling. Froggers can wear their Croll and harness strap continuously without impairment. Several tests conducted on rope indicate that donning a Mitchell chest harness required between 1 and two minutes extra depending upon the type of harness used. With all ascending gear on the caver however, the Frog showed only a tiny time advantage. The Frog's slight

advantage may be offset by the Mitchell's faster ascent times if the overall vertical time is considered (see other test results).

Knot crossing on ascent

For all knot crossing tests, a loop in the main rope allowed safety cowtails to be attached.

The Frog System required about **15-20 seconds** to clip in a cowtail safety, pass both ascenders above the knot and unclip the cowtail safety. The Mitchell System required about **20-30 seconds** to clip in a cowtail safety, pass both ascenders and chest box above the knot and unclip the safety.

The Frog is slightly superior when crossing this obstacle. In both changeovers and knot crossings, the time differences were mainly due to the removal and re-attachment of the Mitchell chest box (averaging about 10 seconds). There was no significant difference in energy expenditure.

Knot crossing on descent

It is possible to cross a knot on descent without full ascending gear. *Since these tests were designed to compare ascending systems, a method utilizing full ascending gear was teste*d. In this test, the caver descends to a point a few feet above the knot, switches to their ascending system, down climbs past the knot and does a changeover to continue the rappel. Two points of contact were maintained at all times.

The Frog system averaged about **1 _ minutes**.
The Mitchell system averaged about **1 _ minutes**.

There was no significant difference in the time required with either system. While the Frog System could be attached to the rope more rapidly than the Mitchell, the Mitchell's superior down-climbing speed made up the time difference. The Mitchell user however, was forced to wear the chest box and foot loops while rappelling. This could be a disadvantage in some circumstances. See the Mitchell-to-Frog conversion article for an alternative knot crossing possibility.

Passing Deviations

There was no difference between the two systems for passing several different deviations. Times are not listed because they seemed to be more dependent upon the nature of the specific deviation and not the ascending system. No ascender was unclipped from the rope to pass any deviation.

"Gearing up and Gearing down"

"Gearing up and down" means taking vertical gear on and off and/or stowing it for travel. Most complaints directed at the Mitchell System were not about the actual "on/off" rope time, but rather that Mitchell users must remove their ascending gear to travel effectively

between drops. This may or may not be a serious concern in practical caving for several reasons. Actual "gearing up" time (putting on vertical gear) only matters for the **first** caver to ascend. In addition, once the Mitchell system is on the caver, the "clip in" time for the Mitchell is actually faster than the Frog (see tests results below). Unless the caver is pushing on alone, "gearing down" time usually coincides with waiting for the next caver to descend. Overall rope occupation time (including all mid-rope obstacles) is far more important than any single aspect of a system when vertical effectiveness is the criteria. Time lost at "clip in" may be regained by climbing with a more effective system. Total energy expenditure of the climber should also be considered.

Fig 5: For "gearing up" tests, systems were placed in a random pile similar to ones left at the bottom of a last pitch. The Mitchell System is at left and the Frog at right. Although the Mitchell System is not sit harness dependent, the same type harness was used for all tests. Cowtails were included for both systems.

The "gearing up" tests

These tests measured how long it took to put on equipment and clip onto the rope ready to ascend. The first test involved putting on ALL vertical gear and clipping into the main rope. The second test measured clipping onto the rope only. The results varied greatly depending upon the test. While it is possible for Mitchell users to ascend without a sit harness and effectively rest on their haunches, we felt that safety concerns prohibit climbing this way except in emergencies. A sit harness was included in gearing up times for the Mitchell system.

Test #1 –Caver starts with no vertical gear (no sit harness, no chest harness etc.). Timing ends when caver has donned full vertical gear, is clipped onto rope in adjusted climbing position and takes first "step." With all of the climbing gear accessible in pile (no searching around in a cave pack or groping for equipment in the dark) it takes an average of about **1 _ minutes** to put on the complete Frog gear and clip onto the main rope. This includes donning the sit harness with Croll ascender and cowtails, attaching the ascenders to the rope and adjusting the chest harness tension for climbing. This is done at a cave worthy pace, not a racing pace.

The Mitchell "gear up" time includes the proper attachment of the sit harness with cowtails (a Croll is not necessary with the Mitchell), both ascenders, and the donning, adjustment and attachment of the double roller chest box to the main rope. This averaged about **2 1/2 minutes**. The increased time was strictly due to donning the chest box. This makes the Frog system a total of about 1 minute faster on average than the Mitchell when gearing up from a "dead start."

Once again, a single test did not account for all real-world conditions. It is reasonable to assume that the Mitchell user would not always be the first person to ascend, so a second test was conducted using different start/stop points.

Test #2 – "Clip in" time only: With all vertical gear on the caver (ready to climb), timing starts when caver attaches first piece of vertical gear to main rope and ends when caver takes first "step": Froggers averaged about **20 seconds** to clip both ascenders onto the main rope, weight the Croll **AND** adjust their chest harness tension properly. Mitchell clip-in time averaged about **10 seconds** when measured to the first "step." The difference was mainly due to the need for Froggers to adjust their chest harnesses AFTER their Croll ascender was loaded. Mitchell users were able to clip in and ascend virtually immediately because the chest harness can be properly tensioned while off rope.

"Gearing down" and Travel efficiency

For "gearing down" the Frog was clearly superior in regard to cavers being ready to travel almost immediately after getting off rope. Froggers need only "stow" their upper ascender by clipping it to their sit harness. This required only **10 seconds** on average. Mitchell users had to remove and stow at least one foot loop and usually the chest box in order to travel, although the chest box need only be loosened, not removed, in some cases. Most Mitchell users were able to remove and stow their foot loops and chest box for travel in about **1 minute**. Gearing down time may be a significant factor depending upon the nature of the cave and the number and spacing of vertical drops.

Results at a glance

Relative system weights (approx)

Frog: **907 g (2.0 lbs)**
Frog with Pantin foot ascender: **987 g (2.2 lbs)**
Mitchell (comfortable system) **1470 g (3.2 lbs)**

Frog (light system): **870 g (1.91 lbs)**
Mitchell (light system): **1200g (2.6 lbs)**

Relative system bulk (approximate)

Mitchell vs. Frog: Mitchell = **+ 50% (average)**
Mitchell vs. Frog with Pantin: Mitchell = **+20% (average)**

Free climbing ascent 20 meters (65 feet) at cave appropriate speed

Mitchell: **30% faster** (average per individual)

Rebelay test #1: rebelay time (cowtail on to cowtail off - average time)

Frog: **15 seconds**
Mitchell: **30 seconds**

Rebelay test #2: rebelay time (cowtail on to 3 meter (10 foot) ascent above rebelay)

Frog: **30 seconds**
Mitchell: **40 seconds**

Changeovers: ascent to descent (average)

Frog: **40 seconds**
Mitchell: **45 seconds**

Changeovers: descent to ascent (average with all vertical gear on)

Frog: **40 seconds**
Mitchell: **45 seconds**

Knot crossing on ascent

Frog: **20 seconds**
Mitchell: **30 seconds**

Knot crossing on descent (wearing full gear)

Frog: **1.5 minutes**
Mitchell: **1.5 minutes**

Note: the Mitchell chest box need not be worn to cross a knot safely on rappel.

"Gearing up" (putting on ALL necessary vertical gear to first "step" on rope)

Frog: **1.5 minutes**
Mitchell: **2.5 minutes (average)**

"Gearing down" (travel readiness between ropes on descent)

Frog: **10 seconds**
Mitchell: **1 minute**

Clip in time (ready to climb, all gear on, clip onto rope, take first "step")

Frog: **20 seconds**
Mitchell: **10 seconds**

"Statistics don't lie, but liars use statistics"

It is essential that the relative importance of each test be evaluated in terms of *overall vertical effectiveness*. It is galactically stupid to limit criticism to specific situations (either favorable or unfavorable) simply to justify an opinion. Adherence to situational arguments is the sanctuary of the feeble-minded and Speleo politicians. Here's why:

Situational argument #1: Statistically, the Frog System can be said to be *overwhelmingly* superior because it is measurably faster than the Mitchell when crossing most obstacles and performing most rope maneuvers. **HOWEVER**, the differences are small in most cases and amount to an insignificant percentage of the TOTAL time spent on rope.

Situational argument #2: Statistically, the Mitchell System can be said to be *overwhelmingly* superior because during the majority of the time spent on rope (actual climbing) it is demonstrably faster than the Frog System with the same climber. This makes it superior for 95% of the *rope time* for almost any caver using it properly. **HOWEVER**, some of its disadvantages cannot be discussed in rope terms alone. Extra weight and bulk have an indirect effect on overall vertical effectiveness because they affect the caver both on and off rope and therefore for a larger percentage of the caving trip. These effects are difficult to quantify, but they cannot be ignored.

Considerations

I tried to avoid the fanaticism from both sides of the issue by basing my judgments on the essential question: *If two cavers were placed into the same circumstances using these two different ascending systems, what would be the overall efficiency of those cavers individually and indirectly for the group as a whole?* It is important to remember several things about these tests and my conclusions:

1. These are empirical tests. I did not confuse them with scientific tests and you should not either. I do not consider these tests definitive, just indicative.
2. We must assume equal physical condition for all climbers for comparison purposes. The actual effects of personal conditioning are extremely difficult to test. Done properly with both systems, there is little practical energy expenditure at rebelays, knot crossings, or other mid-rope obstacles.
3. Specific circumstances alter the effectiveness of either system. Tight crevices can jam Mitchell chest boxes. Climbing times for Froggers are always longer on all but the shortest drops.
4. It is imperative that certain tests be conducted with *experienced* system users with PROPERLY adjusted equipment. I have seen poorly constructed systems of both types in publication and in use. Inefficient systems and/or inexperience yield false results.
5. Don't try to justify an opinion. Try to form an intelligent one. Ignorance is the greatest obstacle.

Conclusions

My tests indicate that the most common arguments favoring either the Mitchell or Frog Systems are based more upon prejudice than fact. Whatever practical problems may exist with either system, the ones that cavers constantly argue about make little or no difference in overall vertical efficiency. Both systems are completely compatible with Alpine SRT methods and neither shows a definitive overall advantage in practical caving when total rope occupation time and/or energy expenditure is considered.

1. The greater the number of rope obstacles, the more efficient the Frog becomes.
2. The longer or more obstacle-free the drop(s), the more efficient the Mitchell becomes.
3. It takes a lot of rope obstacles to make any significant difference in overall rope occupation times. With the exception of relatively short drops (10 meters or less), the slower times for the Mitchell at rope obstacles are almost always compensated for by faster climbing rates.
4. Specific circumstances can significantly affect the effectiveness of either system.
5. The Frog System favors specific body types. See my article "Typecasting the Vertical Caver" for specifics. The Mitchell is less affected overall.
6. Overall vertical effectiveness of some individuals is significantly improved by ascending systems better suited to their body type. This improves group effectiveness.
7. Overall rope occupation times are virtually identical between the two systems when all factors and potential caving conditions are considered. Energy expenditure is significantly less with the Mitchell System during actual climbing, but greater equipment weight and bulk may offset this advantage during off rope travel.
8. Experienced Mitchell System users would not negatively affect the total rope time under real-world Alpine SRT rigging conditions. Switching systems however, may significantly increase the vertical effectiveness of specific individuals.
9. A dogmatic approach to ascending systems is counterproductive to some individuals and therefore counterproductive to any group with whom those individuals go caving.
10. Tests can be deliberately designed to favor either system, yielding false results.