

# ROMBO Fire Saw Accident

## Facilitated Learning Analysis

### August 14, 2007

On August 14, 2007 an experienced Hot Shot Crew Squad Boss suffered broken ribs when a small snag fell back to where he had felled a green tree. This report describes the event utilizing the Facilitated Learning Analysis (FLA) principles. In this approach the salient points are identified by the crew, the injured firefighter, operations overhead, and the FLA team and are presented to promote the values of a Learning Organization.

The FLS Team included:

Paul Chamberlin  
Garrett Olson  
Larry Castro

Northern Rockies Fire Ops Safety  
Missoula Smokejumper, Tech Specialist, and C Sawyer  
Yosemite National Park, Saw Expert (assigned to fire)

## The Event

### **What was planned?**

The hotshot crew was reducing tree hazards in preparation of Type 2 crews moving into the area for mop-up. In a particularly 'jack strawed' area, the squad boss, a seasoned firefighter and sawyer, elected to saw himself, feeling responsible for the safety of his crew. At the location of the accident, he did not engage the entangled matt of trees, but chose to drive down the whole mess with a 14 inch dbh, 65 foot green tree. Swampers and other sawyers were off to the side, approximately 100 feet and 45 degrees off the back, along a previously identified and mostly clear escape route.



The pre-determined escape route was up and to the left. This is where crewmembers watched.

Flat cuts with 3+ inch stump shot





The stump reveals proper cuts, executed at a height allowing the sawyer to watch the top of the tree. The injury was caused by the snag lying above the stump and saw in this picture.

## **What Actually Happened?**

The saw cuts were well done, with a wide-mouthed undercut and a horizontal back cut over 3 inches above the undercut. Both cuts were made from the right (as seen from behind the tree, looking in the direction of fall). Wedges were not used, as the tree had an ideal lean towards the target. The green tree left the stump as planned and landed on target. The sawyer was about 3 to 4 feet away and about 45° towards the rear, on the opposite side as the escape route. The sawyer said he learned earlier that in this area falling debris was an issue for almost a minute after falling a tree, and was watching the sky above the trees path.

A snag, to the right of the target area, was somehow dislodged, and fell back, hitting the sawyer in the ribs on the back right quadrant of his torso. The snag fell very quickly, and he was unable to get away.

Crew EMTs initiated a helicopter medical evacuation that went smoothly. The sawyer was treated at a local hospital, and is expected to make a complete recovery.



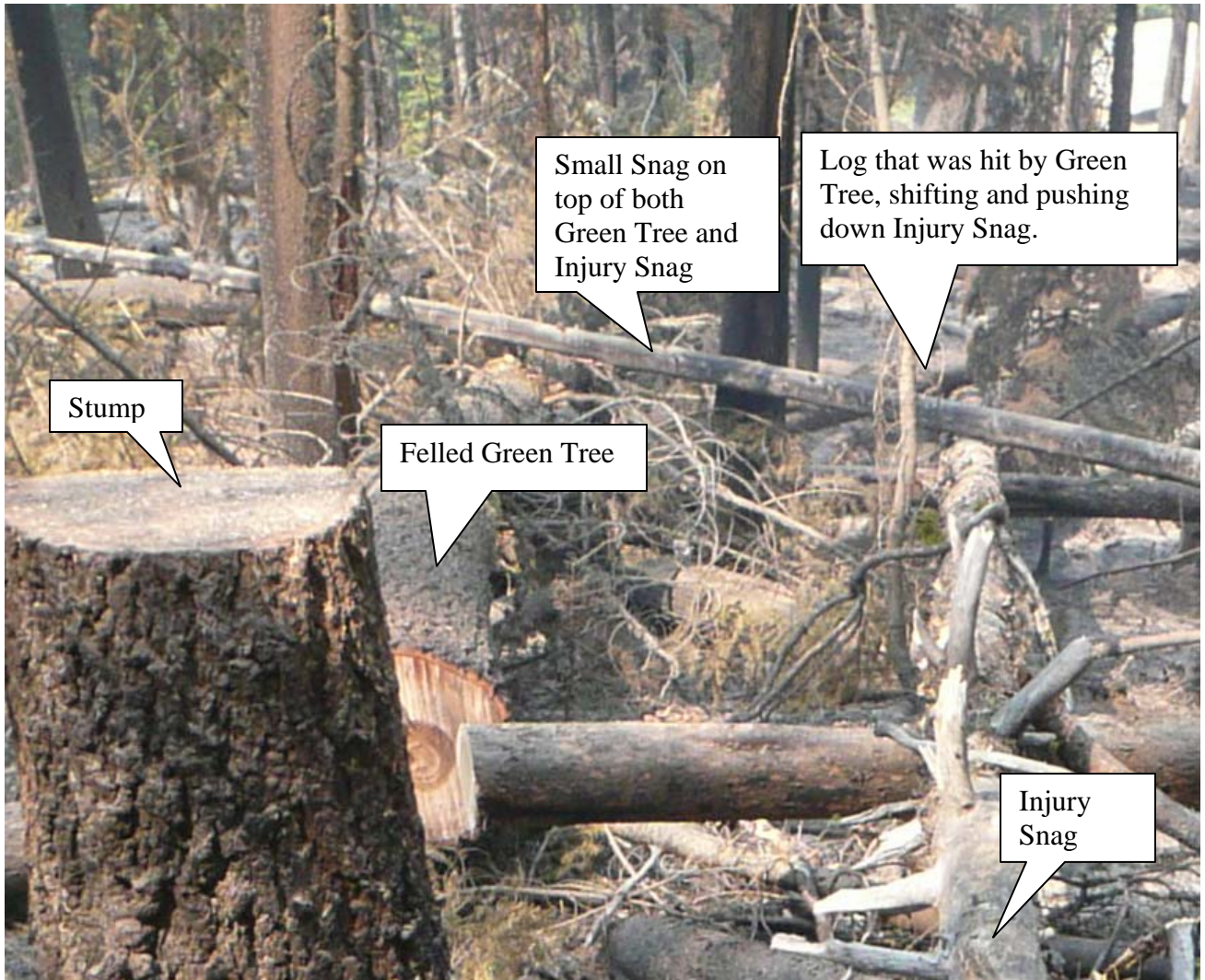
## Why did it happen?

Interviews with the injured sawyer, crew members, and a saw expert suggest the snag was previously leaning approximately 45 degrees away from the sawyer, off to the right. (Said another way; if the snag would have fallen before being dislodged by the green tree, it would have fallen with the top landing about 30 feet to the sawyer's right.) The felled green tree hit an intermediate tree, which then hit the injury snag, breaking it off its thin remaining stump and shifting its butt to align with the sawyer. There is evidence the snag had further force exerted along its base that accelerated its decent. (See following two photos)



A small snag lies from right to left across the injury snag and the fallen green tree. Further down the injury snag is a second log lying below the green tree, but above the injury snag. (*See the blow-up picture next page.*)

It is likely this second log was pushed over by the green tree, hit the injury snag moving its base to align with the sawyer, and accelerated its fall towards the sawyer.



### **What can I/we do differently next time?**

“What Can Go Wrong Will Go Wrong”, or in terms of High Reliability Organizations (HRO), “HROs are Preoccupied With Failure”.

The sawyer, crewmembers, crew Superintendent, Safety Officer, and Incident Commander are questioning if firefighters should have been in this area, considering the difficult tree conditions. They were engaged here to mop up the fire close (100 feet) from the control line. However, a Division Supervisor points out that this area is representative of many, if not most of the fire, and many other fires. Many sawyers may not consider this situation particularly dangerous, and may also take it on.

Everyone interviewed has thought deeply, searching for different ways to safely conduct an operation of this nature. They make the following suggestions:

1) Survey all the trees that can possibly, even remotely become involved, and determine an escape route, and escape distance that will get them clear of worst case scenarios. The time to very quickly move out is as the tree first starts to tip, using the first 45 degrees of fall to get far away.

2) Survey the trees that can possibly, even remotely become involved, and clear them from the drop zone.

The USFS Health and Safety Code Handbook is an important reference, particularly when one considers these entries are in bold type, indicating employees have been killed in similar incidents.

**Page 20-52 Walk out and thoroughly check the intended lay or bed of the tree, look for dead tree tops, missing tree tops, widow-makers, snags, and ground debris that may cause kickbacks, rolling, or result in another tree or limb becoming a hazard.**

**Page 20-55-b As tree lift begins, check the direction the tree is falling. Proceed along the predetermined escape path to your safety zone. Keep alert for falling debris and kickback.**

One of the unresolved paradoxes in tree falling is the need to be exiting the area without tripping, while simultaneously watching for falling debris. Falling debris is sometimes used as a rationale for not racing away, however complacency is also often a factor.

When we do an operation one way, and suffer no ill consequence, in a sense we get positive reinforcement for what may be sloppy behavior. Habits formed during less critical routine situations must prepare sawyers for these particularly challenging situations. As the sawyer was aware this was a more serious situation (he chose to saw himself), Situational Awareness was up, and suggests this is a good time to use the best of practices (H&S Code).

## **Recommendations**

Increase and broaden our collective knowledge regarding the critical dynamics and timing from when a cut tree breaks loose, as it falls, encounters debris enroute, and interacts with material on the ground.

- 1) Conduct sand table exercises with scaled down trees to convey the concepts identified below. Produce a PowerPoint presentation to support these sand table exercises.
- 2) Develop videos, including “6 Minutes for Safety” designed to analyze a tree falling, from vertical to hitting the ground. (See Appendix A) Each point expressed will demonstrate the reasons a sawyer must practice sound techniques.
- 3) Develop field exercises to normalize desired behavior, as the ‘Sim Limb’ exercise has promoted looking up.
  - a) Practice leaving the stump.
  - b) Purposely launching debris from ground based arrangements of logs and poles hit by felled trees. The intent is to calibrate sawyer’s eyes to recognize potential traps.
  - c) Purposely launch debris from arched small (less than 20 foot) trees like a sling shot or catapult. The intent is to calibrate sawyers eyes to recognize situations where debris may be thrown back.



## **Discussion Points:**

- 1) What is a good reference for analyzing the work we do?
- 2) What is indicated when a supervisor feels the work may be unsafe for subordinates?
- 3) What is agency policy regarding the proximity of other people?
- 4) What are the purposes of a wedge?
- 5) What issues emerge when felling trees in thick timber?
- 6) Is driving down a 'jack-strawed mess' with a sound tree appropriate? Can it be accomplished safely?



- 7) Looking at this picture and the picture on page 3, do you see other hazards? How can these hazards be mitigated?
- 8) Discuss the implications of the sawyer executing a backcut from the side opposite the escape route.

9) The Health and Safety Code Handbook requires the sawyer to identify and prepare a primary and alternate escape path. What situation may cause the sawyer to use the alternate, and when will that decision be made? Is there time? What competing factors cause this to be a challenge?

10) 'Walk through' a typical felling operation and discuss where the sawyer's attention and vision should be directed at each phase.

11) The principle reason to exit the stump area is to avoid being hit by debris falling from the felled tree. Was that the factor on this incident? Are there still lessons to be learned from this event regarding leaving the stump area? Are these situations Black and White?

12) Discuss why do so many sawyers remain within 10 feet of the stump? How many times can one get away with this unsafe act?



# Rombo Snag Accident

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### Appendix A

#### “When a Tree Falls”

To promote safe practice and habits, produce a short video that dissects and analyses five phases of a falling tree. This video is intended to challenge firefighters and fallers to consider where their attention should be focused at each step.

The five phases of a falling tree are:

- 1) As the tree begins to tip, the worst place to be is near the stump because of debris possibly falling from the tree itself.
- 2) The moments a tree begins to tip from vertical to its final direction of fall is critical, and small forces (including wind, vibration and a miss calculation of lean / limb weight) can cause the tree to fall in an unplanned direction. This can be mitigated with a wedge in the back-cut kerf.
- 3) The time a tree moves from vertical to about 45 degrees is when the speeds and forces are least (in terms of limbs and tops gaining energy to spring back) and provides the best opportunity for a sawyer to get clear. (Question: Do trees, regardless of size, take the same time to fall to the ground?)
- 4) The tree rapidly accelerates as it falls from 45 degrees to the ground. This is the period when the most powerful energy is communicated to adjacent trees, limbs and tops, and when bent trees are most likely to throw dangerous debris, often in a direction towards the sawyer.
- 5) As mentioned in the Health and Safety Code, **“snags and ground debris can cause kickbacks, rolling, or result in another tree or limb becoming a hazard”**. These forces and mechanisms are not well studied, and are therefore often missed or under predicted.