



# Managing Risk While Stabilizing Failed Trees

## A Framework for Safe Operations





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BCMA, TRAQ, RCA  
BS Forestry University of Vermont  
9 Years in Arboriculture**



- Full time climbing arborist
  - Rope access specialist
  - Extensive crane usage
  - Mostly close quarters work
- Mountain experience
  - Technical Ski Mountaineer
  - Ski Patrol
  - Rock Climber



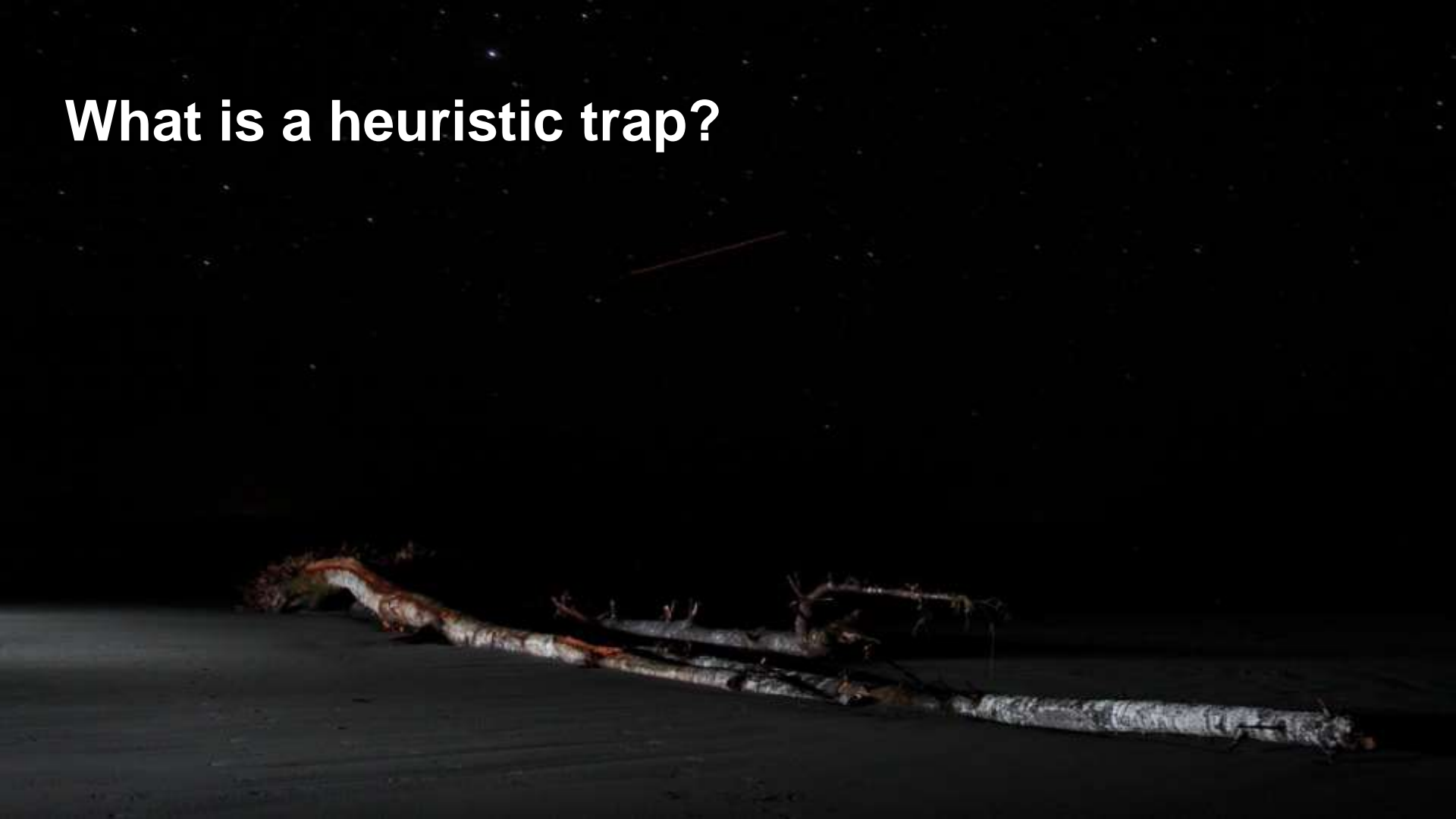


# A Framework For Approaching Failed Trees

- **Prepare**
- **Assess**
- **Safely Access**
- **Stabilize**
- **Remove**
- **Remediate**
- **Review**



**What is a heuristic trap?**





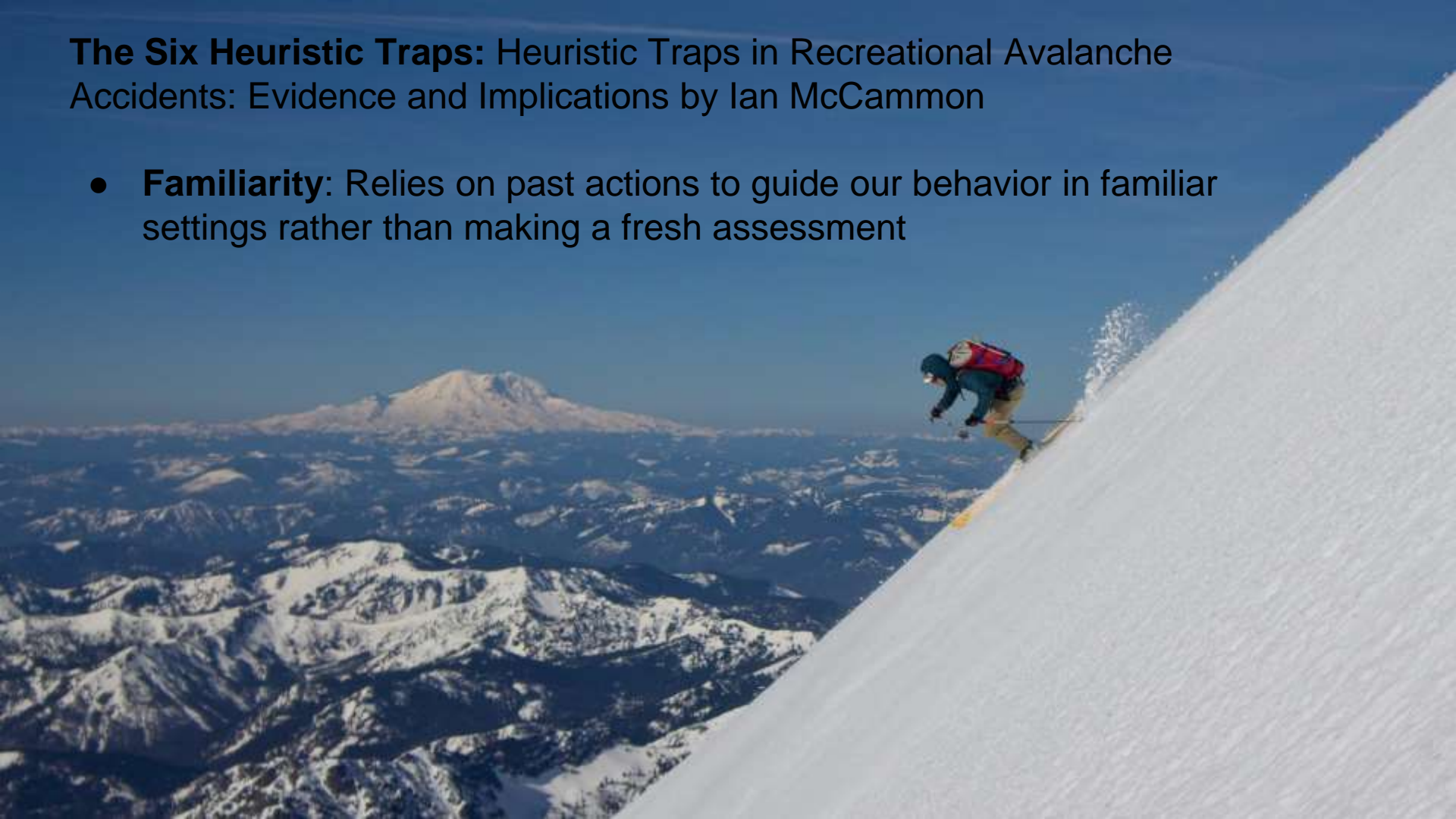
**Heuristics: Humans make 95% of their decisions using mental shortcuts or rules of thumb.**

## **Heuristic Trap:**

- **A mental shortcut that allows us to reach a short-term goal by defying sensible logic or common sense.**
- **Extensively studied in social and experimental psychology**
- **Form the basis of many advertising messages**

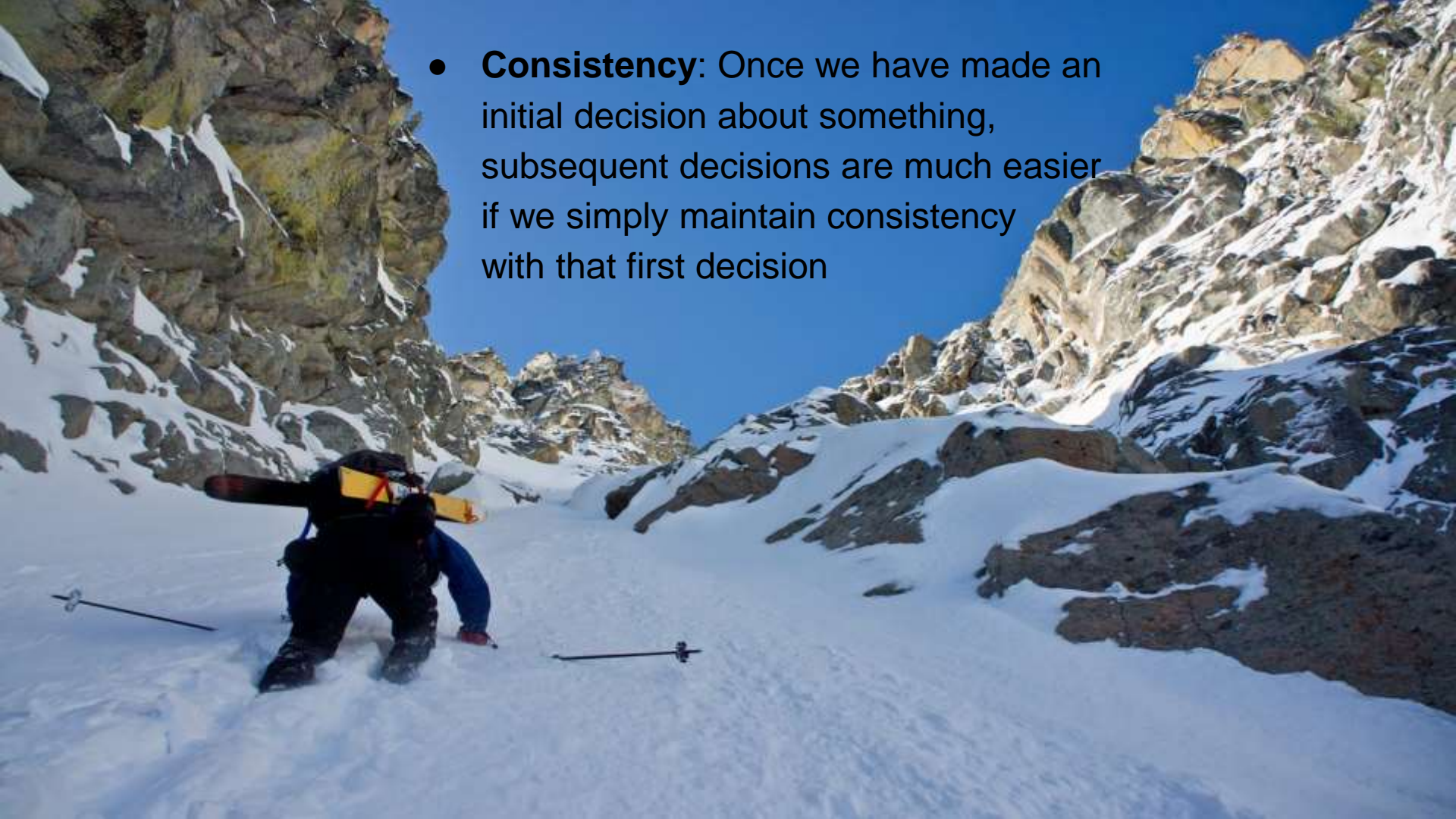
# The Six Heuristic Traps: Heuristic Traps in Recreational Avalanche Accidents: Evidence and Implications by Ian McCammon

- **Familiarity:** Relies on past actions to guide our behavior in familiar settings rather than making a fresh assessment



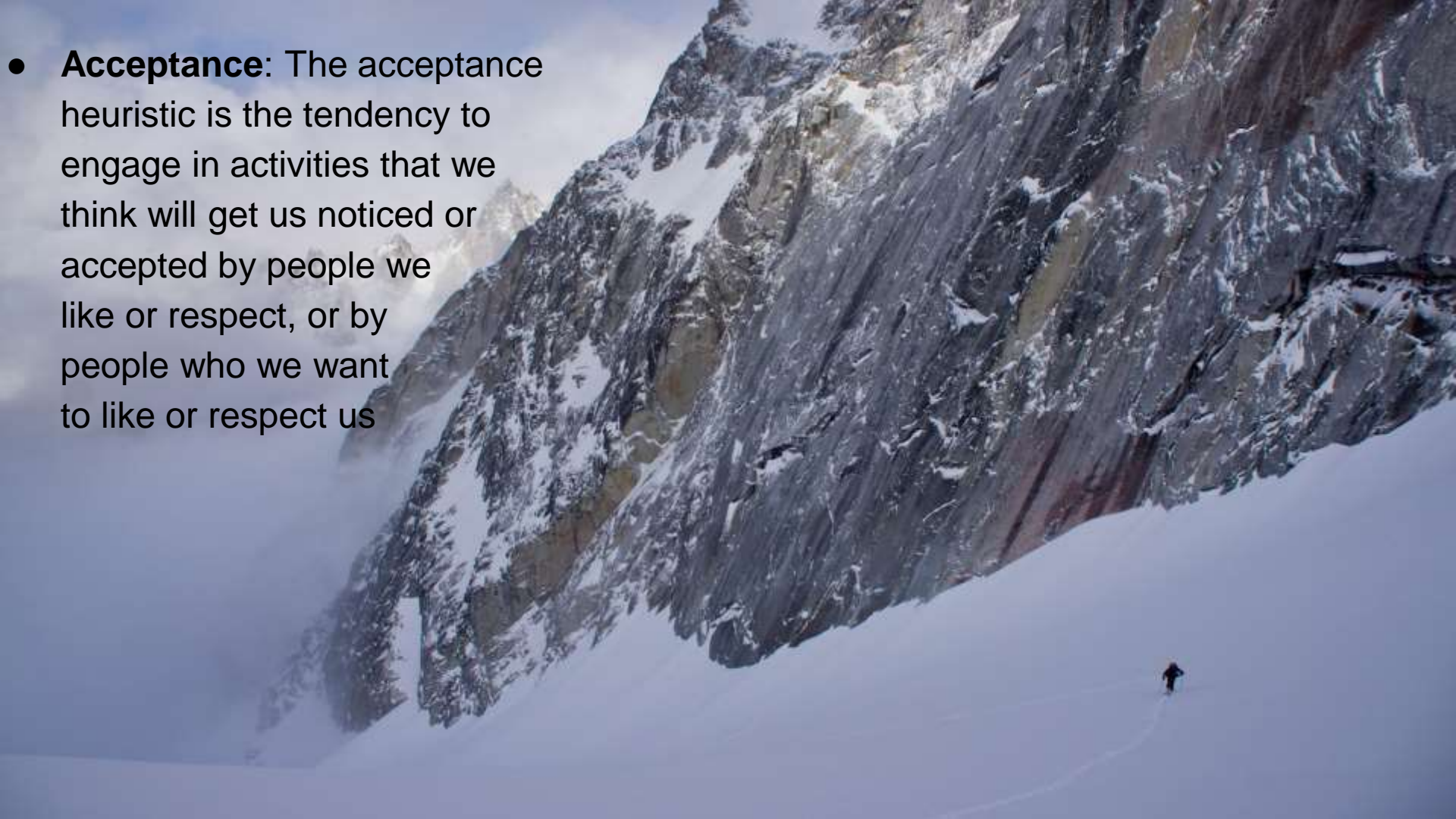


- **Consistency:** Once we have made an initial decision about something, subsequent decisions are much easier if we simply maintain consistency with that first decision

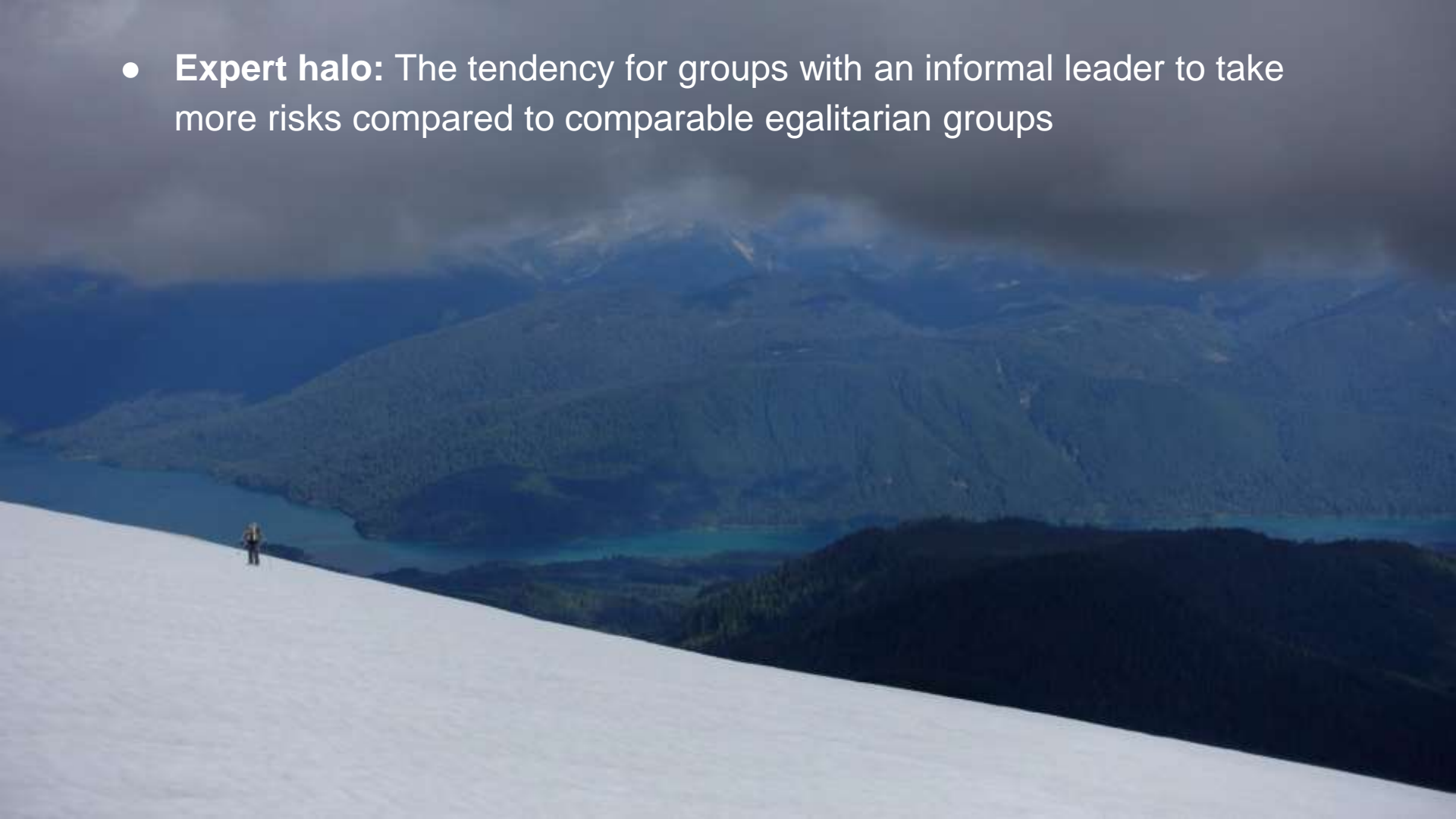




- **Acceptance:** The acceptance heuristic is the tendency to engage in activities that we think will get us noticed or accepted by people we like or respect, or by people who we want to like or respect us

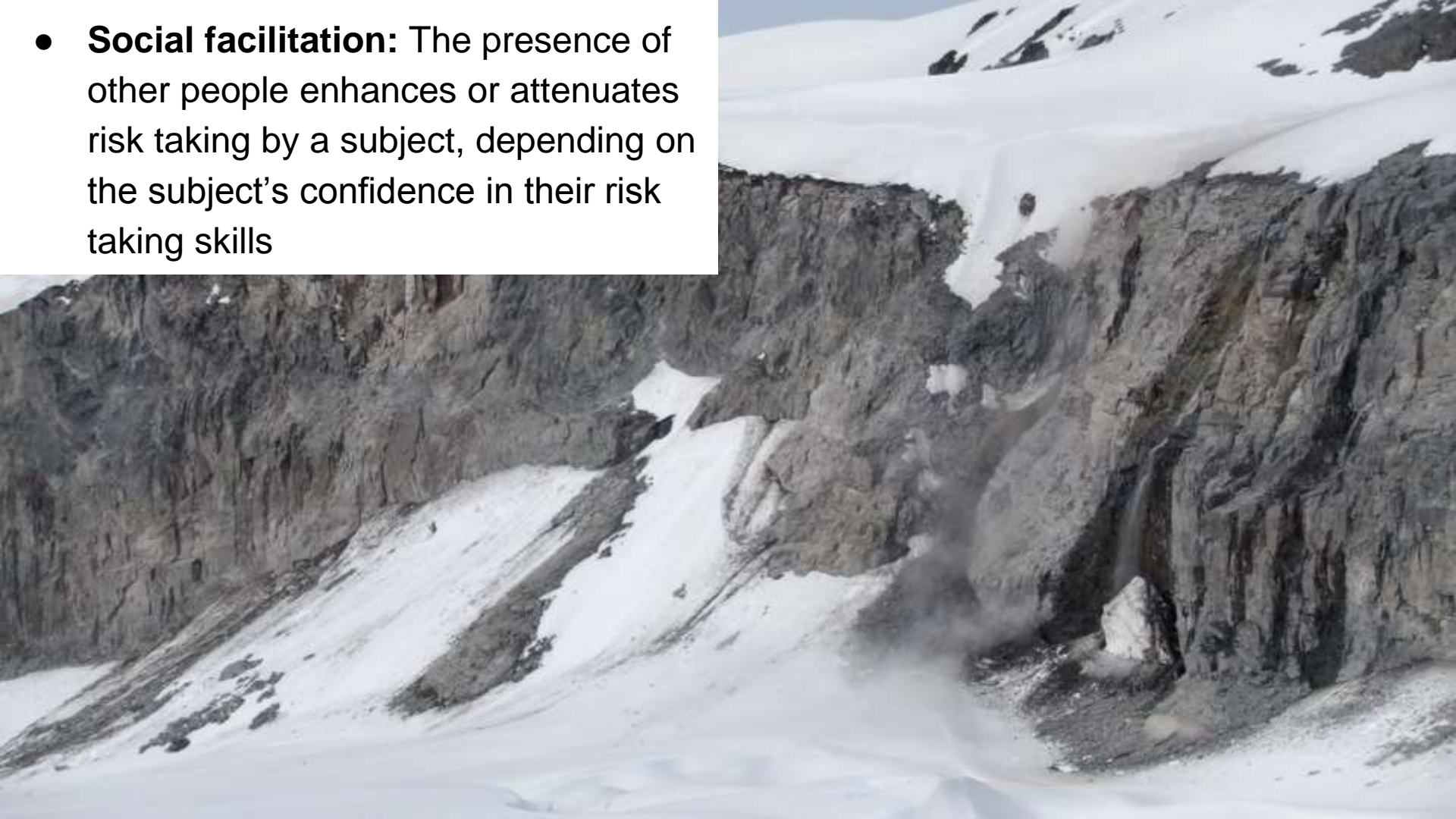


- **Expert halo:** The tendency for groups with an informal leader to take more risks compared to comparable egalitarian groups





- **Social facilitation:** The presence of other people enhances or attenuates risk taking by a subject, depending on the subject's confidence in their risk taking skills



- **Scarcity:** The tendency to value resources or opportunities in proportion to the chance that you may lose them





Which Heuristic Trap do you think is most applicable to cleaning up storm damage?

Which Heuristic Trap do you think is most applicable to general tree work?

- Familiarity
- Consistency
- Acceptance
- Expert halo
- Social facilitation
- Scarcity



# Tools For Safely Approaching Hazardous Situations:

- Rigorous structures and hierarchies
- A framework approach
- Checklists as part of a framework approach can help keep us out of heuristic traps





Aviation can be a great example of this: Americans have a 1 in 114 chance of dying in a car crash, according to the National Safety Council. The odds of dying in air and space transport incidents, which include private flights and air taxis, are 1 in 9,821.<sup>1</sup>

- Pilots rely heavily on checklists

1: Jenkins, A. (2017, July 20). Which Is Safer: Airplanes or Cars? Retrieved November 24, 2018, from <http://fortune.com/2017/07/20/are-airplanes-safer-than-cars/>


**SEABOARD  
WORLD AIRLINES**  
**747F**  
 NORMAL OPERATING CHECKLIST

**BEFORE STARTING**

• INS	3 CKD/ALIGN
• O <sub>2</sub> & INTERPHONE	ON 100% CKD/BOOM
• STATIC SOURCE SEL	NORMAL
• ANTI-SKID	ON
• BODY GEAR STEERING	ARM
• AUTO BRAKE	LDG-OFF
• COMPASS CONTROLLERS	SLAVED
• EMERGENCY LIGHTS	ARMED
• SEAT BELT, NO SMOKE	ON
• ALT FLAPS	OFF
• STALL WARNING	TEST/NORMAL
• MACH A/S	TEST
• NACELLE & WING ANTI-ICE	OFF
• PROBE HEAT	PITOTS ONLY
• WINDOW HEAT	ON
• EXTERIOR LIGHTS	SET
• RADIO INS SWITCH	RADIO
• NAV RADIOS/AUTO FLT PANEL	CKD/SET
• GROUND PROX	TEST
• FLT MODE ANNUNCIATORS	TEST
• FLT INSTR/FLT DIR/ALTS	CKD/TEST/SET
• RADIO ALT	TEST
• RESERVE BRAKE	CKD/CLOSED
• LDG GEAR	DOWN/GREEN
• SPEED BRAKE	FWD DETENT
• THROTTLES/START LEVERS	CLOSED/CUTOFF
• PARK BRAKE	SET/PRESS CKD
• SELCAL/RADAR & TRANSPONDER	SET/STBY
• ELECTRICAL PANEL	SET
• OIL QUANTITY	NORMAL
• FUEL QTY/GROSS WT	LBS/SET
• FIRE WARNING	TEST
• WT & BALANCE	LBS/%
• ANTI SKID GROUND MODE	TEST
• FLT RECORDER	TEST/SET

**PRIOR TO PUSH BACK/START**

• INS	3 NAV
• BEACON	ON
• HYDRAULICS	#1 ADP/#4 ELEC PUMP ON
• DOORS	CKD/LTS OUT
• EVAC SLIDES	LATCHED & AUTO
• FUEL BOOST PUMPS	ON

• REQUIRED AT TRANSIT STATIONS

**BEFORE TAXI**

START ARM SWITCH	OFF
ELECTRICAL POWER	SET
APU BLEED	CLOSE
HYDRAULICS	AUTO/NORMAL/QTY CKD
SEAT BELTS & SHLDR HARNESS	ON
GEAR & NOSE STEER PINS	REMOVED/CKD
GROUND EQUIPMENT	DISCONNECT/CLEAR

**TAXI CHECK**

NACELLE ANTI-ICE	SET
FLAPS	GREEN LIGHTS/DETENT
CONTROLS	CKD
STAB & TRIM	THREE SET
TAKE OFF DATA	CKD/SET
FLT & NAV INSTRUMENTS	X-CKD/SET
ALTITUDE SELECT	SET
APU	SHUT DOWN
CARGO HEAT	NORMAL
FUEL HEAT	OFF
FUEL SYS	SET/MAIN BOOST PUMPS ON
IGNITION	FLT START
ANNUNCIATOR LIGHTS	CKD
AIR COND	SET

**BEFORE TAKE OFF**

LANDING & STROBE LIGHTS	ON
TRANSPONDER	ON
AUTO BRAKE	ARM
BODY GEAR	DISARM

**CLIMB**

LANDING GEAR	UP & OFF
FLAPS	UP-LIGHTS OUT
PROBE HEAT	ON
NO SMOKE	OFF
IGNITION	SET
FUEL SCHED	SET
AIR COND	SET

**TRANSITION LEVEL CHECK/18,000 FT**

LOGO & LANDING LTS	OFF/10,000'
ALTIMETERS	RESET

**DESCENT**

IGNITION	FLT START
SEATBELTS/SHLDR HARNESS & SIGN	ON
FLT MODE ANNUNCIATORS	TEST
GROUND PROX	TEST
RADIO ALT	TEST/2000
RADIO INS SWITCH	RADIO
PRESSURIZATION	SET
HYDRAULIC SYSTEMS	CKD/NORMAL
FUEL MANAGEMENT	SET FOR LANDING

**18,000 FT/OR/TRANSITION LEVEL CHECK**

ALTIMETERS	SET/X-CKD
LANDING DATA	SET
LANDING & LOGO LIGHTS	ON/10,000'

**APPROACH**

FLAPS	GREEN LIGHT/DETENT
ADF/VOR SWITCHES	SET
RADIO ALT	MDA/DH SET
NACELLE ANTI-ICE	SET
FUEL SYS	MAIN BOOST ON/HEAT OFF
NO SMOKE	ON

**BEFORE LANDING**

LANDING GEAR	DOWN-GREEN LIGHT
AUTO BRAKE	SET/LT OUT
SPEED BRAKE	ARM
FLAPS	SET
FLAG SCAN OM-500'	CALL OUT

**AFTER LANDING**

BODY GEAR STEERING	ARMED
SPEED BRAKE	DOWN/DETENT
FLAPS	UP/LTS OUT
LDG LTS & STROBE LIGHTS	SET
IGNITION	OFF
RADAR & TRANSPONDER	OFF
STABILIZER TRIM	5 SET
BRAKE TEMP & HYDRAULICS	CKD
ANTI-SKID GROUND MODE	TEST
UPPER DECK & CARGO HEAT	OFF
FIRE WARNING	TEST
APU	START

**PARKING**

PARKING BRAKE	SET
APU OR EXTERNAL POWER	CONNECTED
START LEVERS	OFF
SEAT BELT	OFF
PROBE HEAT/WINDOW HEAT	OFF
EXTERIOR LIGHTS	SET
EMERGENCY EXIT LIGHTS	OFF
INS	RECORD 3/OFF
HYDRAULIC AIR PUMPS	OFF
WT & BAL POWER SW	ON
FUEL BOOST PUMPS	OFF
FUEL RESERVE VALVES	CLOSED
STANDBY POWER SWITCH	OFF
RADIO MASTERS	SET

**FOR TERMINATING FLIGHTS**

OXYGEN VALVE	CLOSED
APU	SET
BATTERY	SET

### Tree Failure Response Checklist

If there is a threat to life/limb call 911!

Be prepared to contact local municipal agencies for assistance with other hazards

Crew Lead: \_\_\_\_\_

Crew Members Present: \_\_\_\_\_

Date: \_\_\_\_\_

#### Assess

- ☐ Gather information from a safe place
- ☐ Ensure safe access to tree failure site
- ☐ Ensure deployment of appropriate personnel and equipment
- ☐ Determine critical cut/lift if needed
- ☐ Prepare resources and personnel for critical cut/lift
- ☐ Prepare escape routes for workers involved in critical cut/lift

#### Safety Access

- ☐ Ensure safe access to and from failed tree/tree part on site
- ☐ Prepare a safe workspace for crew and public
- ☐ Check for other hazards
  - ☐ Electrical or other utility
  - ☐ Traffic
  - ☐ Hazards to the public
  - ☐ Other Tree related hazards (Not just the failed tree/tree part)
  - ☐ Other \_\_\_\_\_
- ☐ Restrict access for all persons not involved in work

#### Stabilize

- ☐ Stabilize failed tree/tree part if needed
- ☐ Remove material to isolate point or points of contact if needed
- ☐ Plan for removal of failed tree/tree part
  - ☐ Fall
  - ☐ Rig
  - ☐ Crane
  - ☐ Piece out
  - ☐ Other \_\_\_\_\_

#### Remove

- ☐ Double check systems before making critical cut/lift, modify if needed
- ☐ Communicate with team the expectations and potential reaction of critical cut and make sure everyone understands their role in the operation.
- ☐ Ensure safety of all workers and the public before making critical cut/lift
- ☐ Are the key players in the key position for best possibility for success?
- ☐ Bring failed tree/tree part to the ground safely

#### Remediate

- ☐ Assess safety of site after failed tree/tree part has been removed
- ☐ Perform other remedial actions needed

#### Review

- ☐ Review operations with all present employees
- ☐ Use feedback for continual improvement for next occurrence
- ☐ Revise procedures as needed

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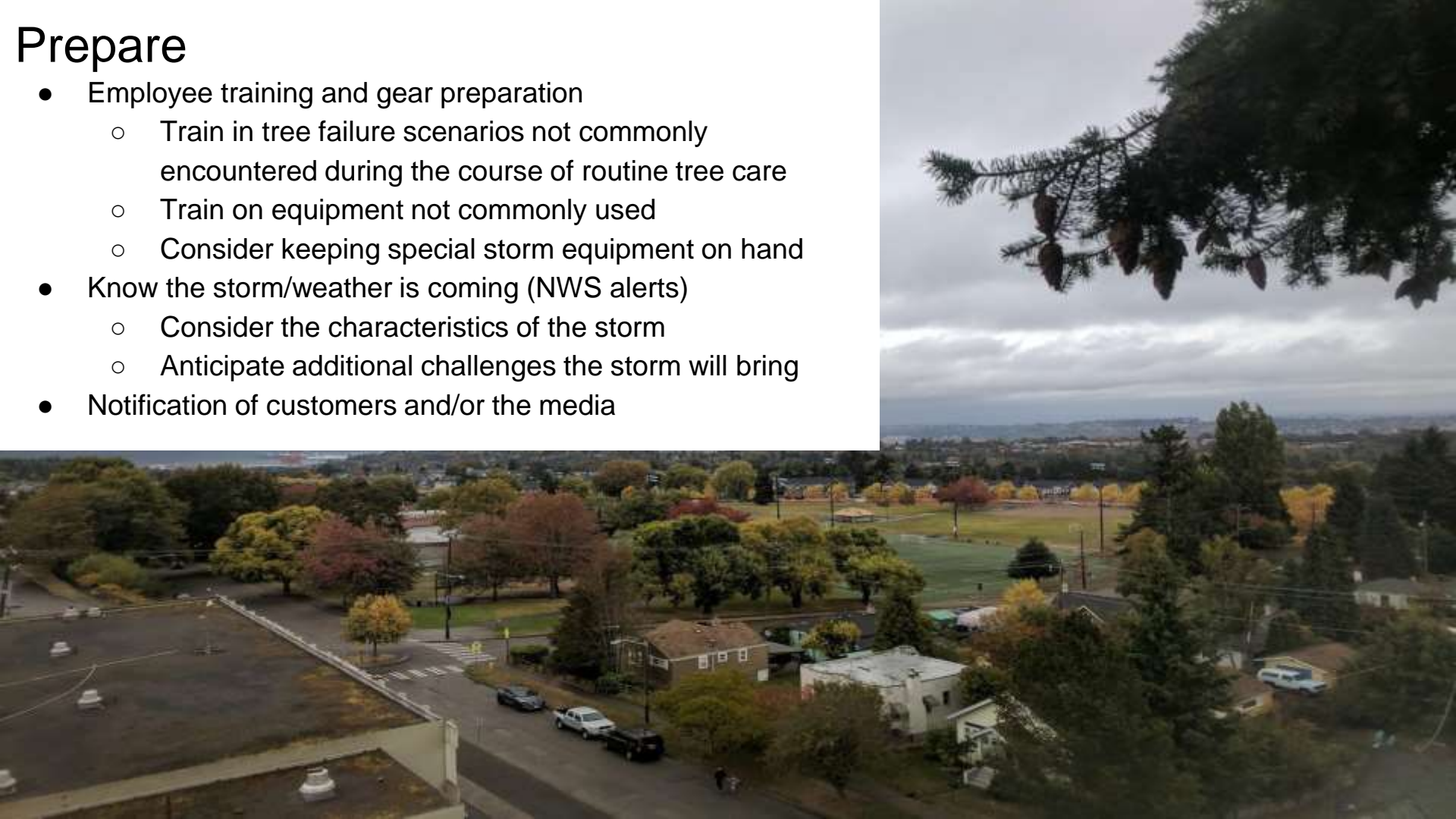
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# Prepare

- Employee training and gear preparation
  - Train in tree failure scenarios not commonly encountered during the course of routine tree care
  - Train on equipment not commonly used
  - Consider keeping special storm equipment on hand
- Know the storm/weather is coming (NWS alerts)
  - Consider the characteristics of the storm
  - Anticipate additional challenges the storm will bring
- Notification of customers and/or the media



# Storm Specific Equipment

- Lights
  - Large work lights
  - Helmet compatible headlamps
- Radios/SENA
- Tire Chains
- Traffic Control
- Rigging
- Familiarize the crew with new equipment before an emergency situation arises





# Assess

- Gather information during the storm
  - Keep in mind that many storm related tree fatalities occur to motorists
  - Gather information digitally
- Make the assessment about when it is safe to go out in the field collect more data
  - Work to triage tree failures
    - Human Risk
    - Transportation
    - Property Damage
- Deploy resources based on the best information you have
  - Be ready to make corrections as new information becomes available



# Safely Access

- Ensure that there is a safe work area with safe access to and from
- Potential Hazards
  - Electrical
  - Hangers
  - Slippery surfaces
  - Unstable tree
  - Steep slopes
  - Water
- Controlling all unsafe conditions, may require waiting for proper authorities (i.e. power)



# Safely Access

- Access to tree/tree part
  - Ground
  - Ladder
  - Tie in to failed tree
  - Tie into adjacent tree(s)
    - Often takes time to do right
  - Aerial lift
  - Roof Access - WA L&I: Must be tied in while on a roof greater than 4' above the ground
  - Crane
  - Other



# Stabilize

- May not be needed if tree/tree part can be felled or free dropped
- Stabilize tree/tree part
  - Ropes/rigging
  - Crane
  - Support structure
  - Other
- Accessing the failed tree part before it is secured or stabilized can be very dangerous
- You may leave the site at this point, returning later to complete the work





# Stabilize

- Find the place/places where the tree/tree part is being supported
- Isolate these area(s) by removing all other material
- Determine critical cut/lift
  - The one cut that transfers everything to the crane/rigging/structure or lets the tree/ tree part free fall



# Remove

- Critical cut/lift: the point where the failed tree/tree part is either allowed to fall or tree/tree part is transferred to or lifted by to your rigging
  - Ensure safe positioning of climber, crew, and the public.
  - Take all reasonable steps to minimize risk
- Bring failed tree safely to the ground
  - May require additional cutting, rigging, or lifting



# Remediate

- Additional work may be required to stabilize remaining tree
  - Pruning
  - Removal
  - Supplemental support
- Cleanup
- Additional remedial actions
  - Tarping roofs for example







## Review:

- Take the time to review work with the crew
- Look for ways to improve
- Ask yourself the hard question: Was the outcome the result of skill or luck?
- It may just be an opportunity to congratulate the crew on a job well done
- Don't forget to make an entry in the PNW Tree Failure Database



# Scenario 1:

- Failed maple tree targeting shed
- Being supported by nearby trees
- No crane/lift access
- Mild Weather







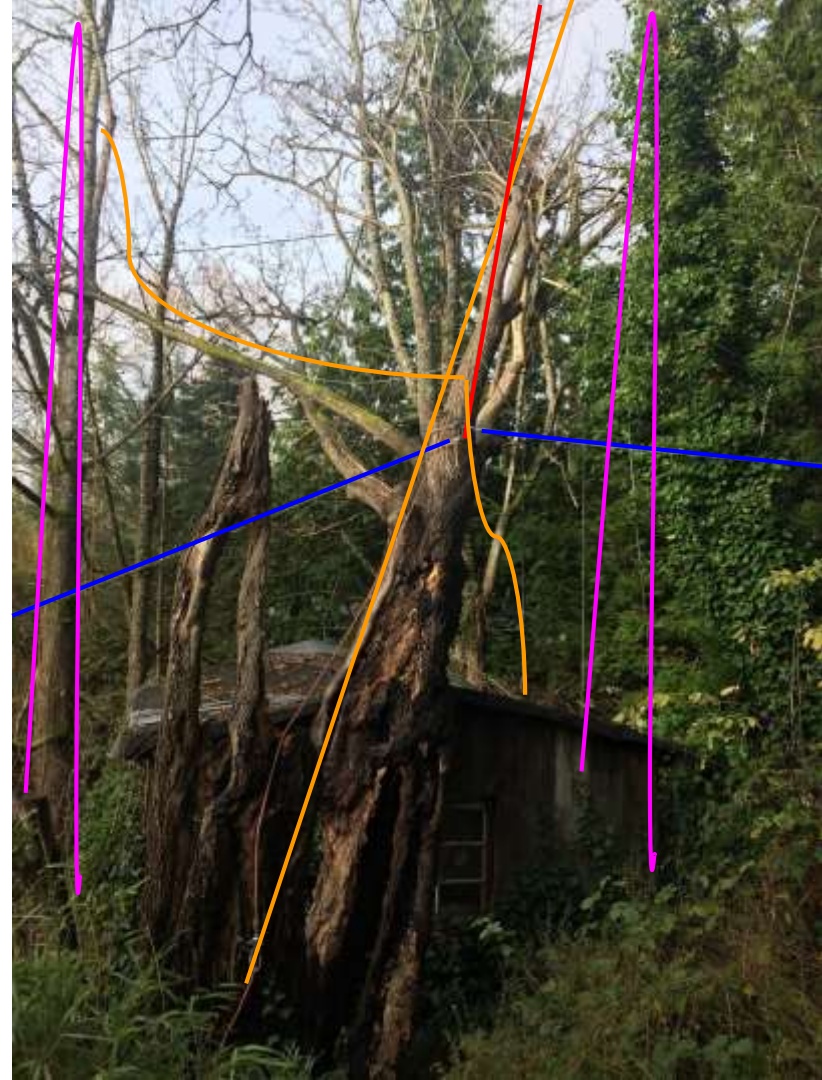


Blue: Guy lines

Orange: SRS climbing lines

Red: Rigging bull line going through block in nearby tree then down to GRCS

Purple: Rigging lines through blocks in nearby trees







# Outcome

- Removed material to isolate primary suspension points
- Critical cuts occurred when tree was cut free of neighboring trees. It was not resting on shed (luckily for the shed)
- Transferred load to rigging as slowly as possible
- Controlled descent with guy lines and GRCS





## Scenario 2:

- Failed locust tree targeting house/yard downslope
- Being supported itself and nearby trees
- No crane/lift access
- Inclement weather: cold rain/wet snow







**Blue:** Rigging line  
**Red:** Rigging bull line going through block in nearby tree then down to GRCS  
**Purple:** Short Rigging line with Munter Mule attachment to secondary, no failed tree  
**Climbing line not visible:** SRS into tree with block,  
**Second climbing system** (smaller photo) to aid in positioning/prevent swing





# Outcome

- Removed material to isolate primary suspension points
- Removed as much material as possible before making critical cut
- Two critical cuts
  - The first cutting the top free of the tree it had landed in and transferring partial load to the purple rigging line
  - Second cut at point of failure to transfer remaining load to rigging line and GRCS
- Slacked short rigging line after making critical cut to transfer full load to GRCS
- Controlled descent with GRCS
- Lowered remaining stem to height of safe habitat snag



## Scenario 3:

- Failed Lawson cypress stem at codominant union with included bark
- Minor impact to nearby house (gutter damage)
- Some impact to fences/landscaping
- Mild weather



- Entirety of failed tree part was removed from the ground
- Some energy in bent branches needed to be carefully released
- Wood was dropped onto the ground





# Outcome

- I determined that the remaining stem posed a threat to nearby targets
- I also determined that the remaining stem was safe to climb
- Remaining stem was removed using standard spur climbing methods (the same day felled tree part was removed)



## Scenario 4:

- Landslide
- Many failed trees and some partially failed trees
- Large remaining tree needed to be assessed to see if it would be safe to use for accessing partially failed trees
  - I determined that it was but added guy lines using a throwball before climbing just to be sure
- All large woody material on ground posed a threat to the house below in the event of another slide
- Work resembled logging more than tree work at times



- Crew was kept busy removing failed stems while I accessed/rigged partially failed stems
- Partially failed stems could not be felled due to sports court below
- Little hazard of familiarity heuristic trap
  - Plenty of hazard from encountering new situations
  - Tried to quote job so that there would be ample time to mitigate hazards (margin)





- Pieced out tops of partially failed stems to isolate suspension points
- Determined that with tops removed stems would be self supporting if cut free
- Risk posed by miscalculation was not grave (damage to fence/court)
- Cut stems free from above so that if they failed they would fall away (critical cuts)
  - Took care to keep my rope tail clear
- Stems were self supporting after being cut free and I was able to bring them down in pieces (still tied into another, safe tree)



# Outcome

- All failed and partially failed stems removed
- Remaining sound trees were preserved to promote slope stabilization
- Slope stabilization left in the hands of homeowner/geotechnical engineer





“An ounce of prevention is worth a pound of cure”

- Benjamin Franklin

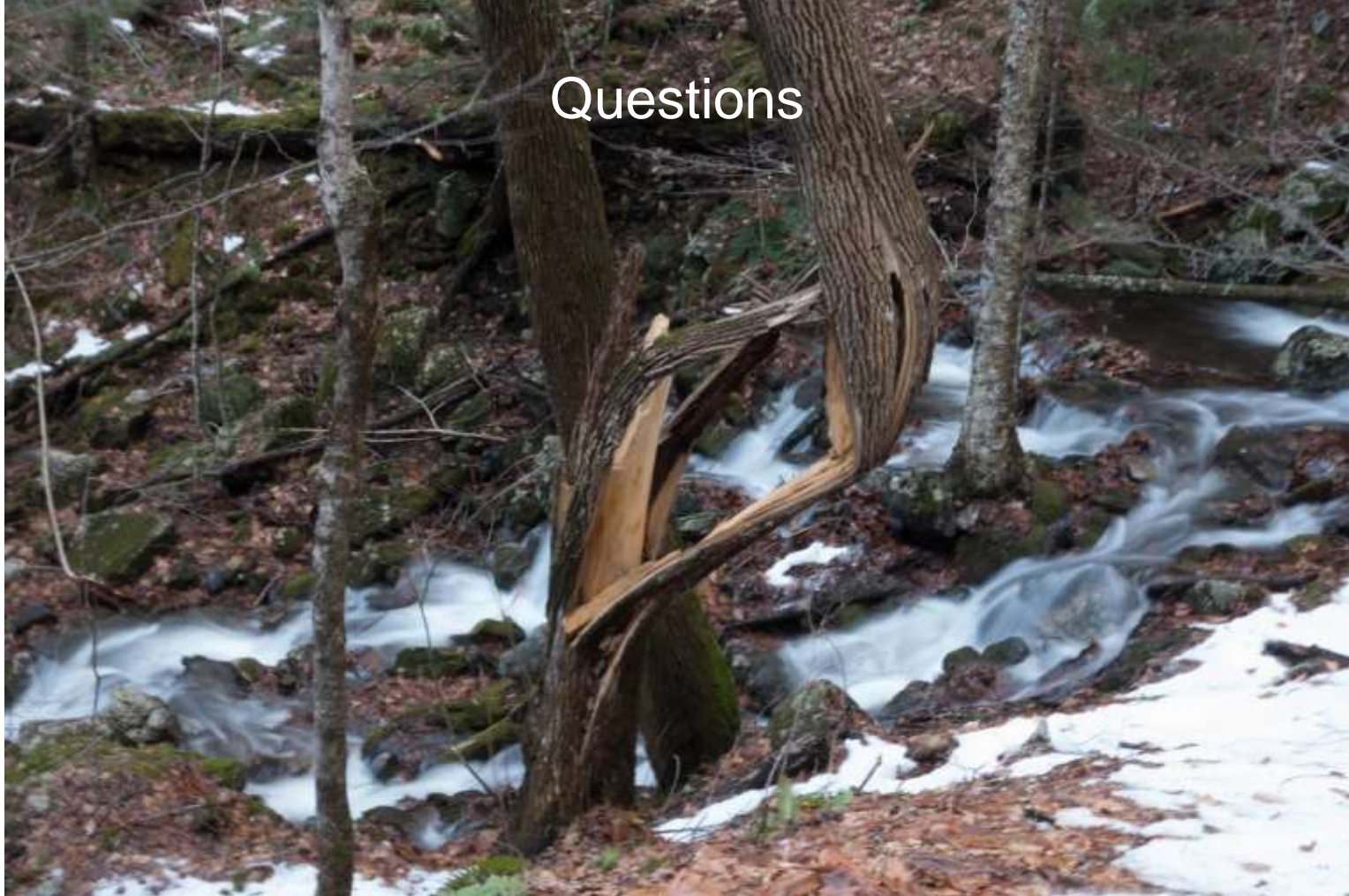
“It is impossible to maintain trees completely free of risk - some level of risk must be accepted to experience the benefits trees Provide”

- Dunster et al. *Tree Risk Assessment Manual, Second Edition*





# Questions



# Resources

## Podcasts

- Freakonomics: The Checklist Manifesto
- NASA The Rocket Ranch: Failure is Not an Option
- Slide: The Avalanche Podcast

## Books

- Atul Gawande *The Checklist Manifesto*
- Bruce Tremper *Staying Alive in Avalanche Terrain*
- Daniel Kahneman *Thinking Fast and Slow*

## Articles

- Powder: The Human Factor



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