CLIMBING INCIDENT ANALYSIS- MAZAMAS CASE STUDY

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MAZAMAS: 1894 – today

The Party from Cloud Cap Inn, as it reached the Summit of Mt. Hood, Thursday, July 19, 1894

- ~3400 members, ~ 600 volunteers

- Mission: The Mazamas promotes mountaineering through education, climbing, hiking, fellowship, safety and the protection of mountain environments.

- ~250 climbs / year, beginning through advanced
- Climbing classes, beginning through advanced, youth / adults
- ~ 900 hikes, backpacks, evening rambles
- Outings (domestic and international)
- Nordic and Ski Mountaineering classes

- Conservation grants- $18500
- Research grants- $16000
- Expedition grants
- Local community youth programs

WWW.MAZAMAS.ORG

AGENDA

- Some background on why and how we developed this analysis
- 3 Key Learnings
    1. Identify top 3 -5 incident types
    2. Brainstorm root causes and factors affecting severity
    3. Test those causes for commonalities that you will share with your leaders/participants
- Mazama analysis findings and challenges
- Brainstorming root cause exercise (20 min)

Initial Mazama incident reporting system (1999) was modeled after *Accidents in North American Mountaineering*

- Published yearly by American Alpine Club
- Compilation of first person reports, SAR analysis, and news reports for US and Canada

ANAM incident types and contributing causes

TABLE III
ACCIDENTS BY CAUSE

	1951–2013 USA	*1959–2013 CAN.	2014 USA	2014 CAN.
Terrain				
Rock	5036	546	84	4
Snow	2582	362	25	3
Ice	290	15	4	2
River	22	3	1	0
Unknown	22	10	0	1
Ascent or Descent				
Ascent	4066	598	66	5
Descent	1275	385	35	5
Unknown	259	13	9	0
Other[1]	21	0	5	0
Immediate Cause				
Fall or slip on rock	3987	297	55	1
Slip on snow or ice	1140	210	12	3
Falling rock, ice, or object	677	141	11	3
Exceeding abilities	583	36	7	0
Illness[2]	444	26	6	1
Stranded	388	60	4	0
Avalanche	323	128	4	0
Rappel Failure/Error[3]	366	52	16	1
Exposure	281	14	1	0
Loss of control/glissade	228	17	3	1
Nut/cam pulled out	284	11	7	0
Failure to follow route	245	35	10	0
Fall into crevasse/moat	185	52	3	0
Faulty use of crampons	124	7	0	0
Piton/ice screw pulled out	95	13	0	0
Ascending too fast	73	0	1	0
Skiing[4]	68	14	2	0
Lightning	67	7	1	0
Equipment failure	16	3	1	0

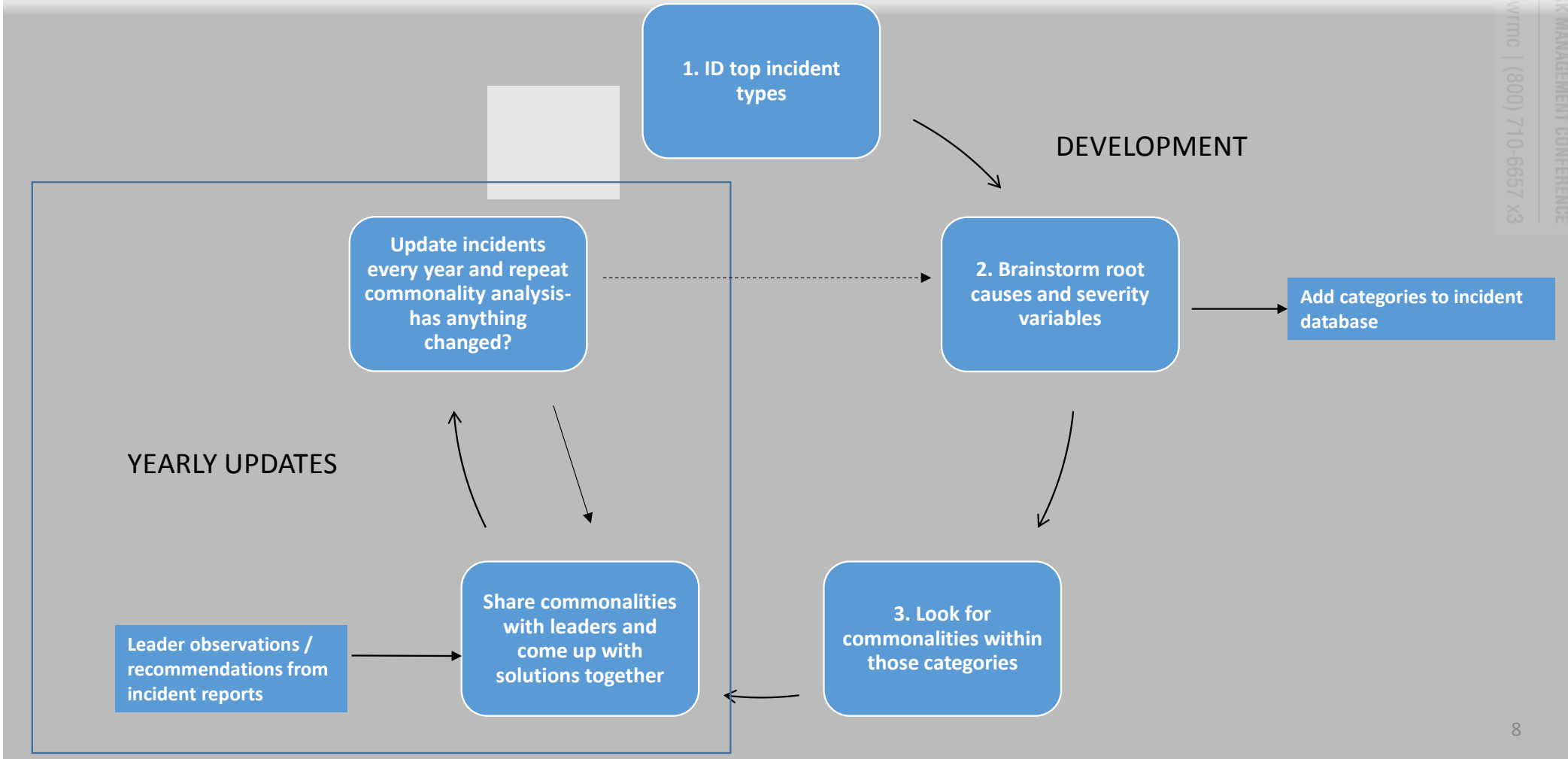
	1951–2013 USA	*1959–2013 CAN.	2014 USA	2014 CAN.
Other[5]	615	38	6	0
Unknown	64	10	3	0
Contributory Causes				
Climbing unroped	1064	169	16	0
Exceeding abilities	1012	206	14	0
Placed no/inadequate protection	871	98	15	2
Inadequate equipment/ clothing	740	72	8	1
Weather	526	73	11	0
Climbing alone	442	72	10	0
No helmet	375	72	6	1
Inadequate belay[6]	268	28	13	0
Nut/cam pulled out	217	32	8	0
Poor position	231	21	9	3
Darkness	171	21	6	0
Party separated	130	12	5	0
Failure to test holds	111	38	6	1
Piton/ice screw pulled out	86	13	0	1
Failed to follow directions	71	13	6	3
Exposure	66	16	1	0
Illness[2]	40	9	0	0
Equipment failure	13	7	6	0
Other[5]	307	100	1	0
Age of Individuals				
Under 15	1248	12	0	0
15-20	1327	204	9	0
21-25	1544	257	17	1
26-30	1456	211	14	0
31-35	2127	115	12	1
36-50	3476	143	19	0
Over 50	384	34	20	1
Unknown	2171	562	31	7

- We needed to expand these types and causes specifically for our organization

We wanted to answer these questions:

- What are our most frequent climbing incidents?
  - Are this year's incident types similar to previous years?
  - What is the amount of near misses, minor injuries, etc. by incident type?
- What are the root cause variables that affect each major incident type and are there any variables that are affecting severity?
  - Do we need to add any new fields to our incident report and database?
- What are the commonalities we need to report to our leaders?
  - Specific mountains / routes?
  - Specific education classes with higher incidents?
  - Are our climbing school graduates having more incidents? If so, are we teaching something incorrectly?
  - Any indication of leader decision making improvements?

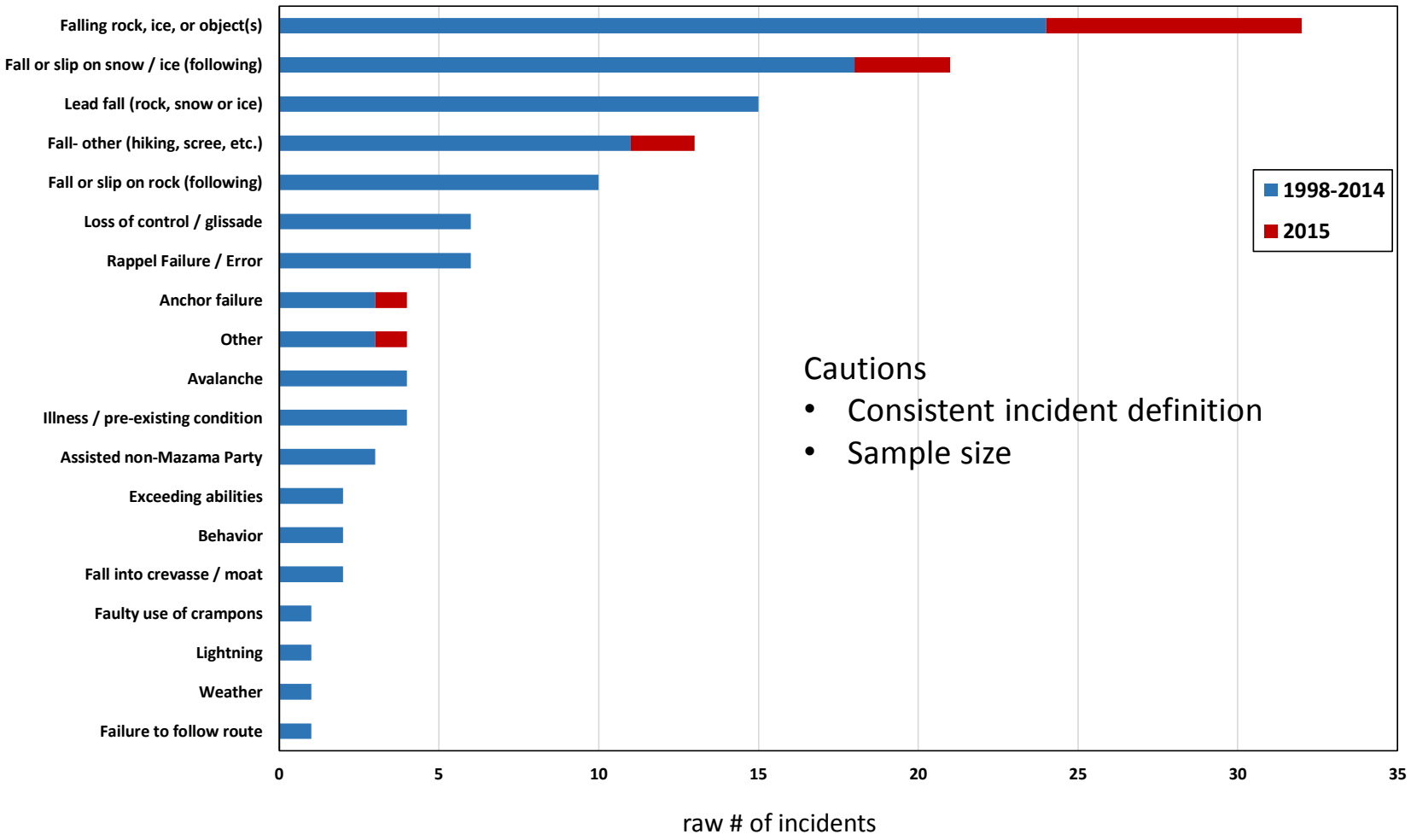
Mazama Climbing Incident Analysis



KEY LEARNING #1: IDENTIFY YOUR TOP 3 – 5 INCIDENTS

- Often done with pie charts
- Prefer a horizontal bar chart sorted by highest to lowest # of occurrences (Pareto)
- Can provide a comparison of current year to previous years
- Can also provide a look at incident categories (near misses, minor injuries, etc.)

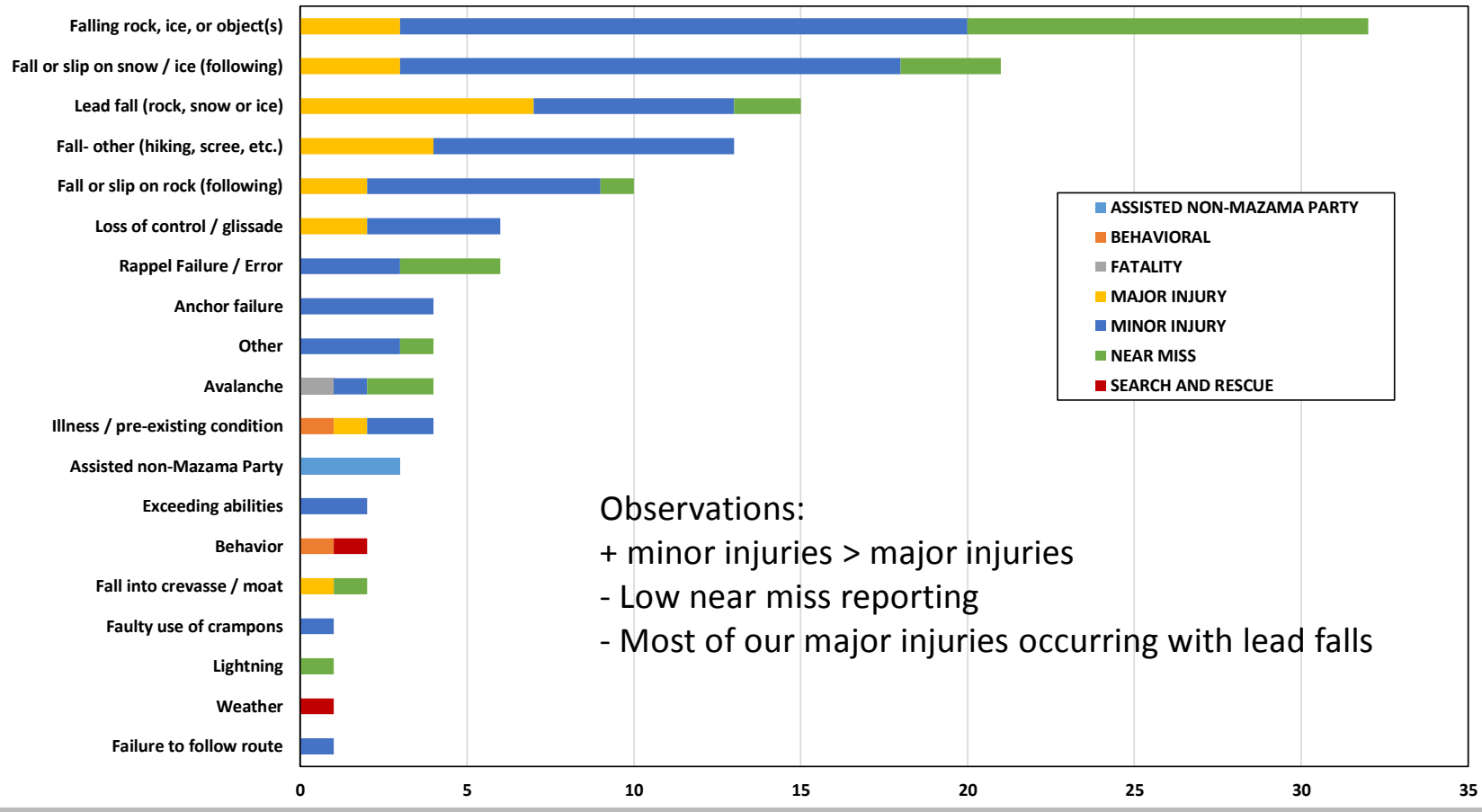
MAZAMA CLIMBING INCIDENTS 1998 - 2015



Cautions

- Consistent incident definition
- Sample size

MAZAMA CLIMBING INCIDENTS 1998 - 2015

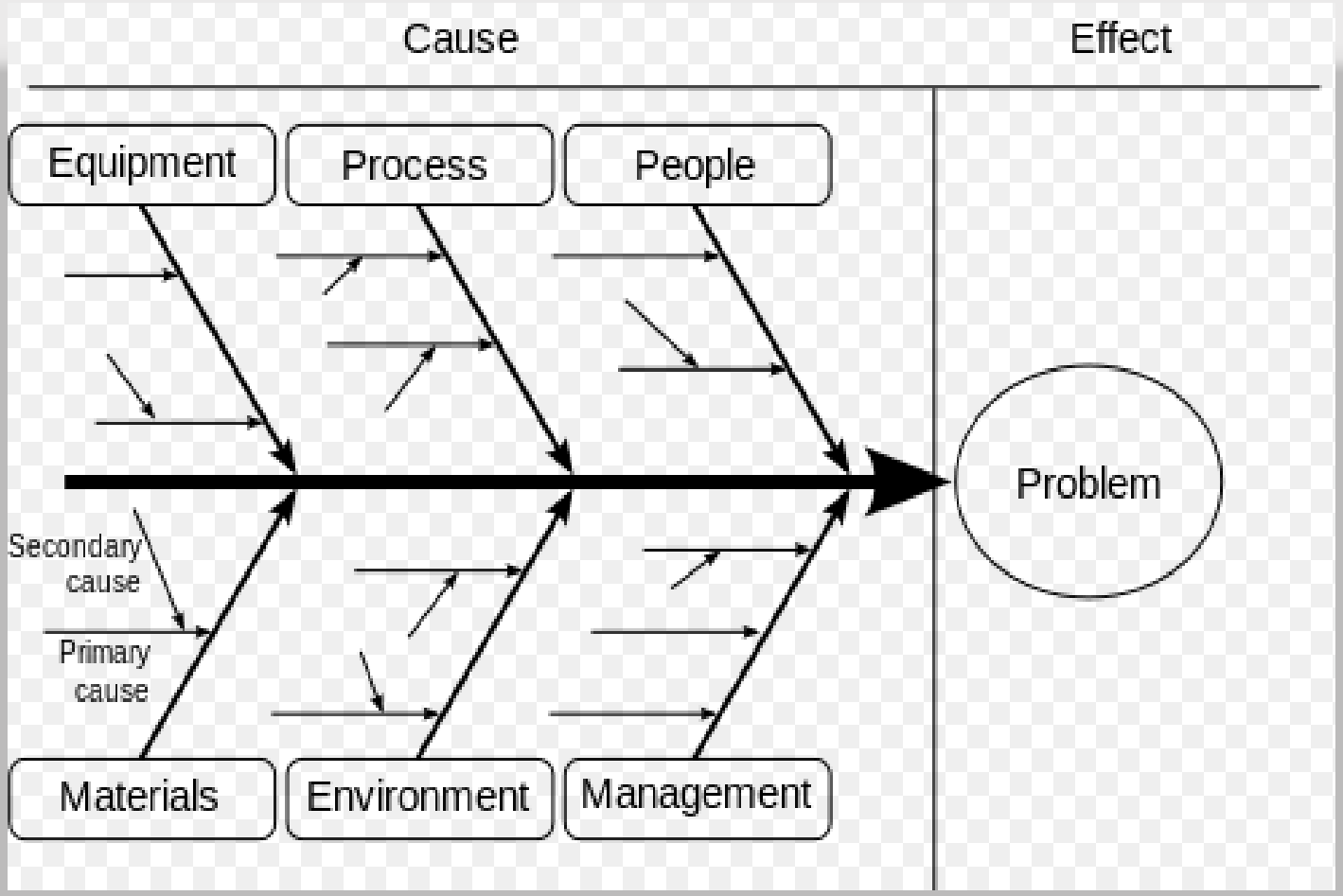


raw # of incidents

KEY LEARNING #2 BRAIN STORM ROOT CAUSES / SEVERITY VARIABLES FOR EACH INCIDENT TYPE

- What known causes are there?
- What other possible issues could have caused the incident?
- What conditions made the incident worse or better?

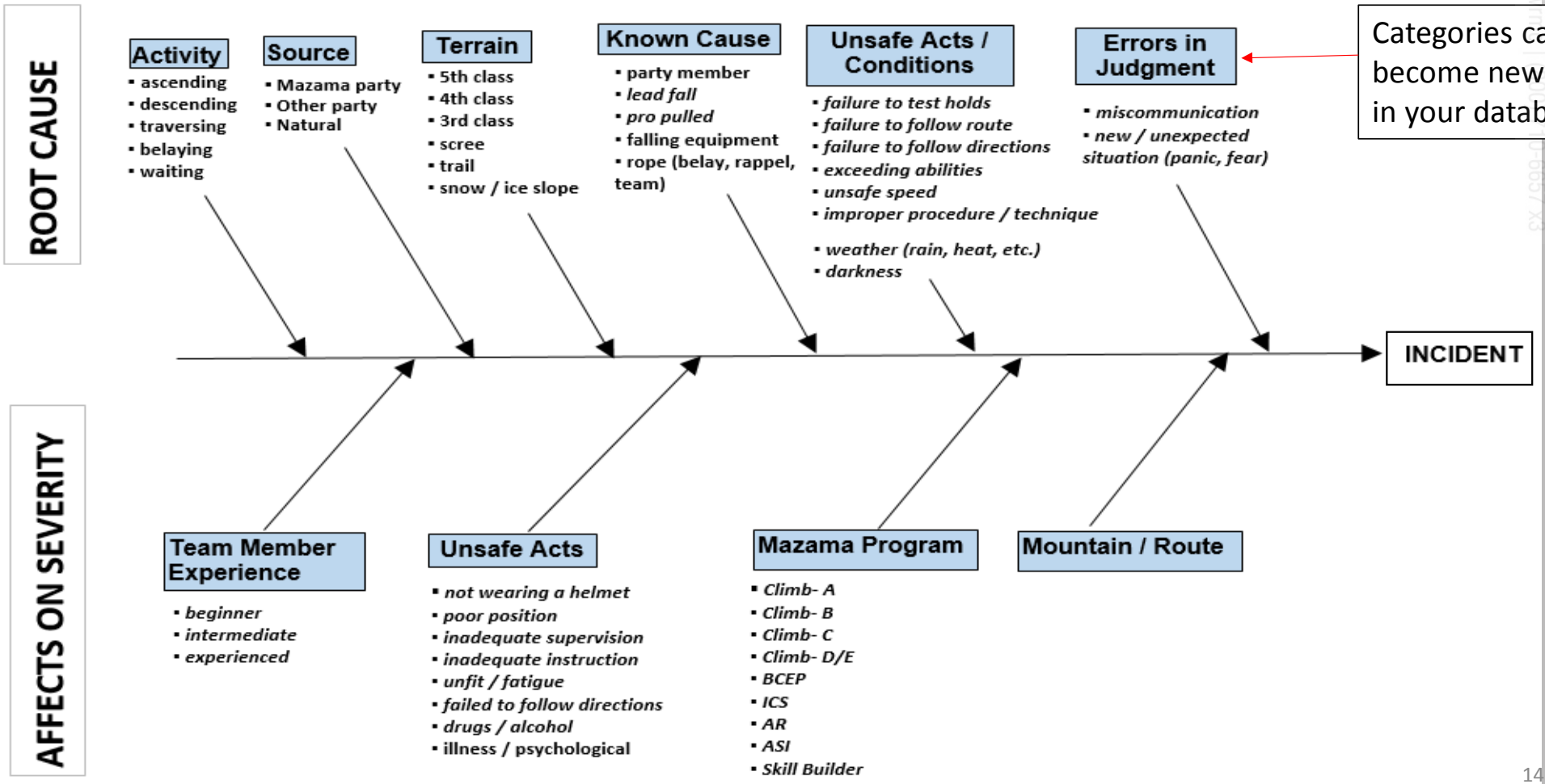
FISHBONE (ISHIKAWA) DIAGRAM EXAMPLE



Source: Wikipedia

- **shows the possible causes of a problem logically arranged by categories**

FISHBONE DIAGRAM APPLIED TO FALLING OBJECTS (ROCK, ICE, EQUIPMENT)

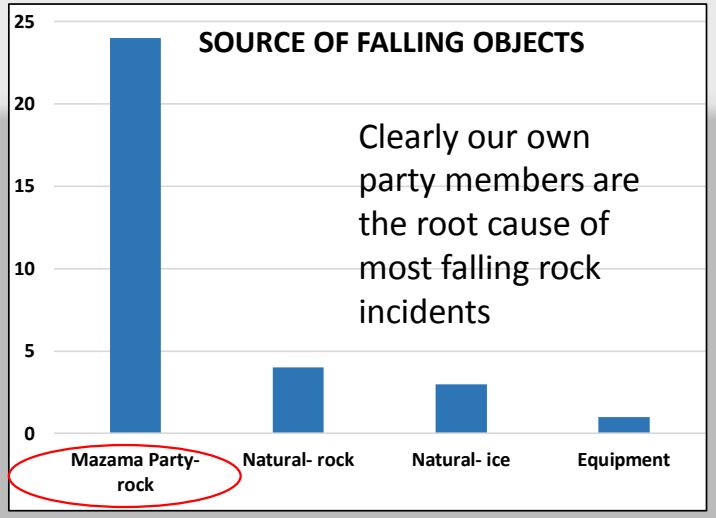


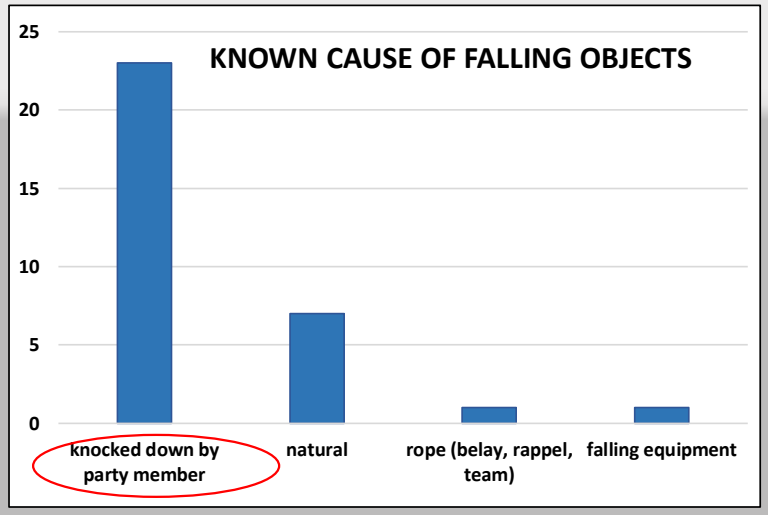
KEY LEARNING #3 TEST VARIABLES FOR COMMONALITIES

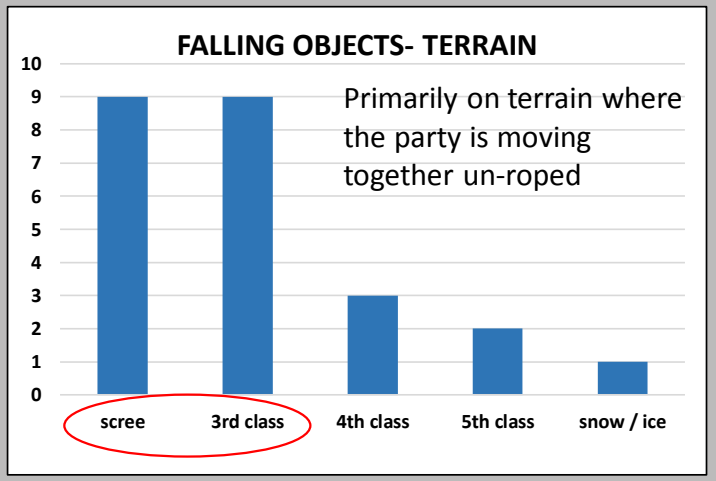
- Add the new category fields in your database and fill in the data using report narratives or interview people that submitted the report

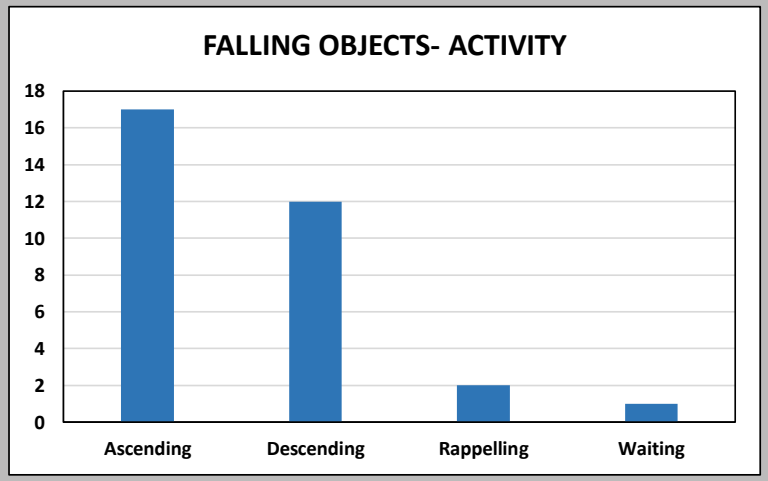
INCIDENT LOCATION / MOUNTAIN	ROUTE / TRAIL	MAZAMA PROGRAM (select ONE)	ACTIVITY	WHAT KIND OF INCIDENT?	SOURCE OF FALLING OBJECTS	ACTIVITY	TERRAIN	KNOWN CAUSE
Pinnacle Peak	South Route	CLIMB- A	CLIMBING- ROCK	Injury, illness, or fatality	Mazama Party- rock	Ascending	3rd class	knocked down by party member
Mt. Stuart	Cascadian Couloir	CLIMB- B	CLIMBING- ROCK	Injury, illness, or fatality	Mazama Party- rock	Ascending	scree	knocked down by party member
Mt. Washington (OLY)	Big Creek	CLIMB- B	CLIMBING- ROCK	Injury, illness, or fatality	Mazama Party- rock	Ascending	3rd class	knocked down by party member
Mt. Jefferson	South Ridge	CLIMB- B	CLIMBING- ROCK	Injury, illness, or fatality	Mazama Party- rock	Descending	3rd class	knocked down by party member
Unicorn Peak	Snow Lake	CLIMB- B	CLIMBING- ROCK	Injury, illness, or fatality	Mazama Party- rock	Ascending	snow / ice	knocked down by party member
Mt. Hood	West Crater Rim	CLIMB- C	CLIMBING- SNOW	Injury, illness, or fatality	Natural- ice	Ascending	snow / ice	natural
Mt. Jefferson	South Ridge	CLIMB- C	CLIMBING - ALPINE	Injury, illness, or fatality	Mazama Party- rock	Ascending	scree	knocked down by party member
Multnoma Falls Trail	n/a	AYM	BACKPACKING	Near miss or close call	Natural- rock	Traversing	trail	natural
Mt. Hood	West Crater Rim	CLIMB- B	CLIMBING- SNOW	Injury, illness, or fatality	Natural- ice	Ascending	snow / ice	natural
Mt. Shuksan	Sulphide Glacier	CLIMB- C	CLIMBING - ALPINE	Near miss or close call	Mazama Party- rock	Ascending	3rd class	knocked down by party member
Mt. Hood	n/a	CLIMBING SCHOOL- ASI	CLIMBING ICE	Injury, illness, or fatality	Natural- ice	Ascending	snow / ice	natural
Broken Top	Northwest Ridge	CLIMB- B	CLIMBING - ALPINE	Injury, illness, or fatality	Mazama Party- rock	Descending	scree	knocked down by party member
Sahale Peak	Sahale Arm	CLIMB- B	CLIMBING - ALPINE	Near miss or close call	Mazama Party- rock	Waiting	5th class	rope (belay, rappel, team)
Sahale Peak	Sahale Arm	CLIMB- B	CLIMBING - ALPINE	Near miss or close call	Mazama Party- rock	Ascending	4th class	knocked down by party member
Mt. Washington	North Ridge	CLIMB- C	CLIMBING- ALPINE	Injury, illness, or fatality	Mazama Party- rock	Descending	scree	knocked down by party member
MMC	climbing wall	CLIMBING SCHOOL- AR	CLIMBING- ROCK	Injury, illness, or fatality	Equipment	Ascending	MMC Wall	falling equipment

KEY LEARNING #3: FALLING OBJECTS- COMMONALITY ANALYSIS



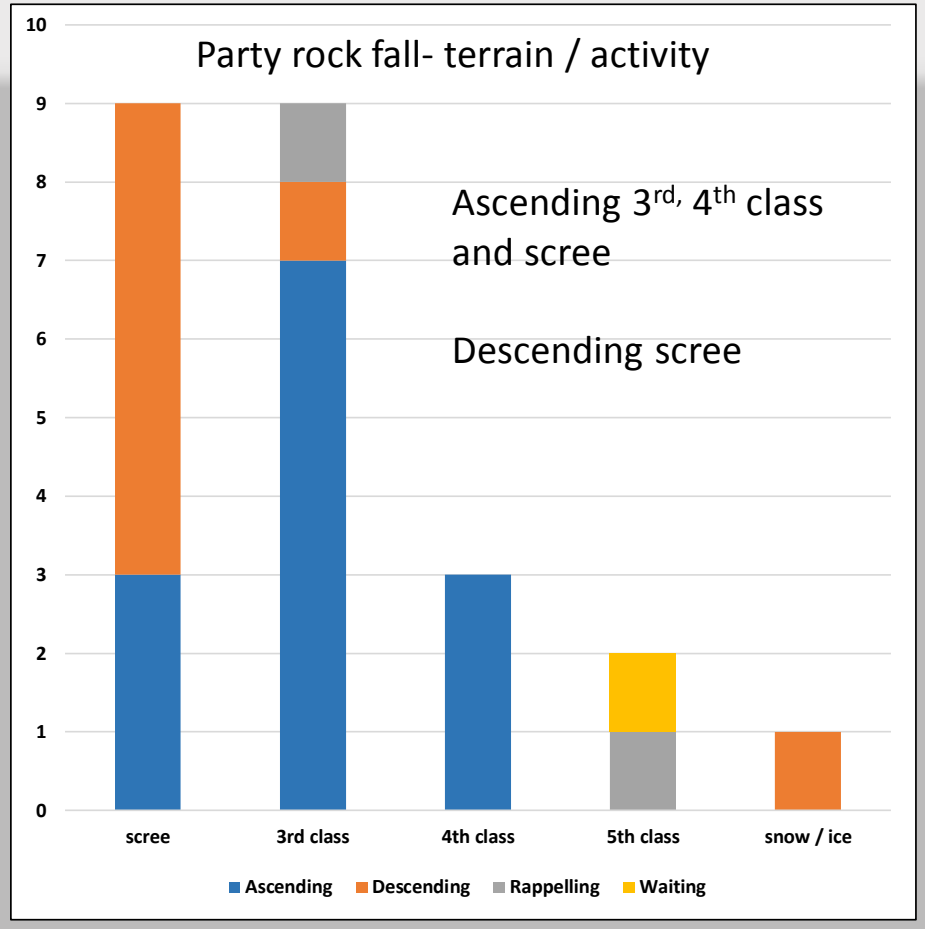


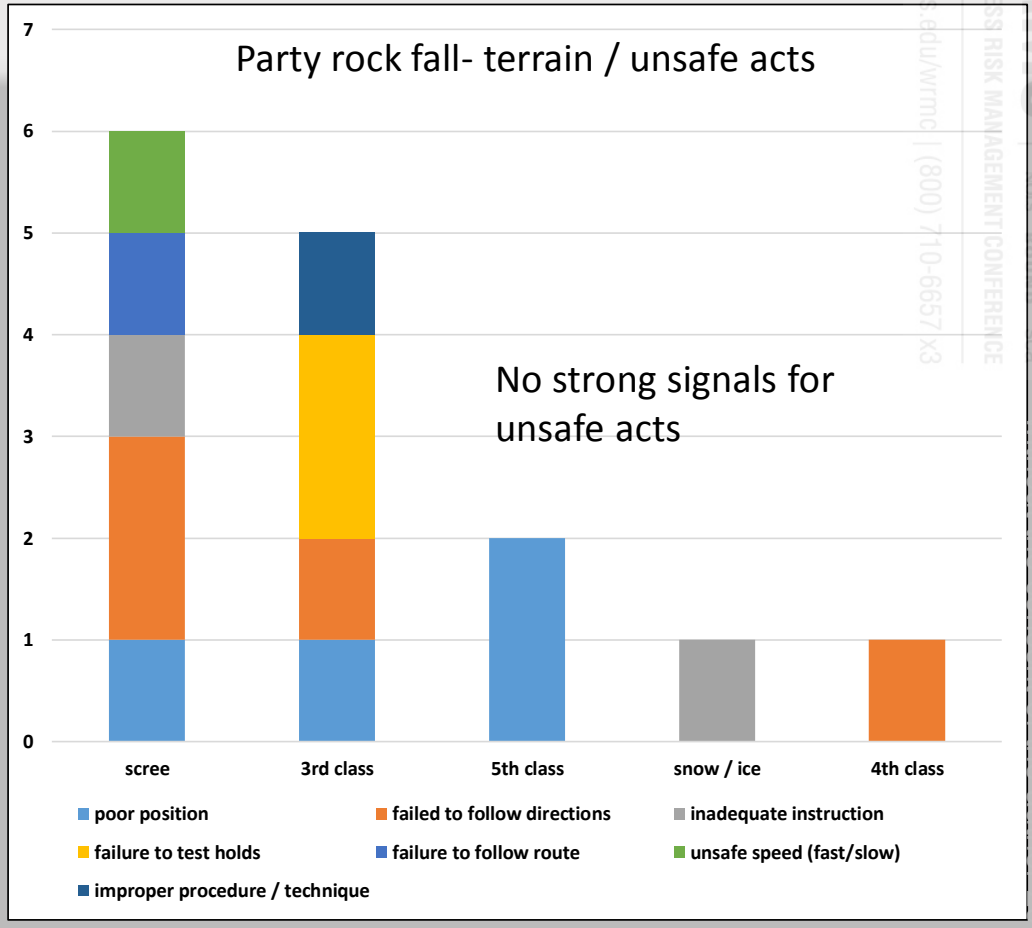




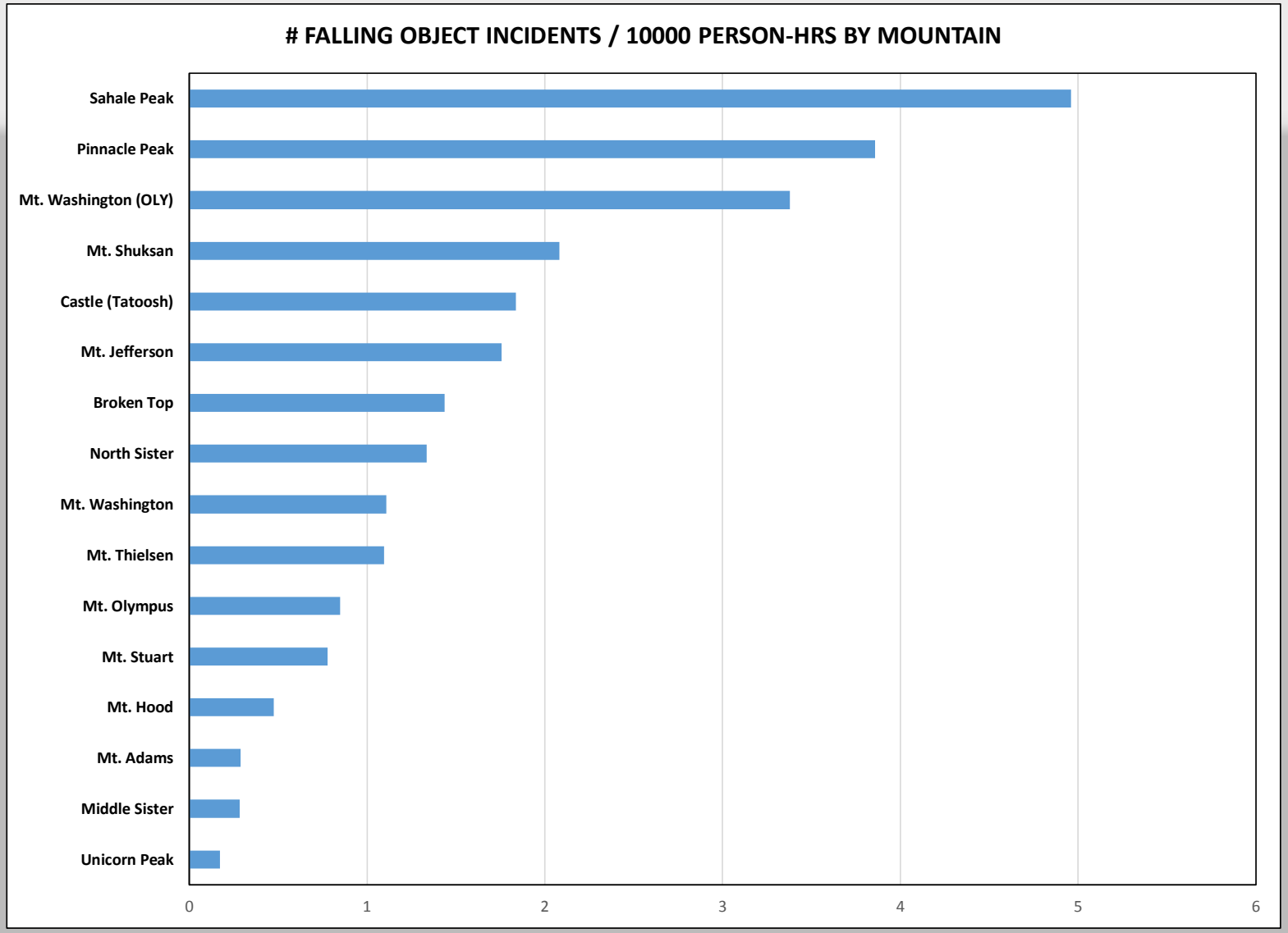
- Start analysis with bar charts for individual category fields from your fish bone diagram

KEY LEARNING #3: FALLING OBJECTS- COMMONALITY ANALYSIS





- Use your expertise to investigate interactions that make sense



Comparisons of sub-groups of different sizes / total time in the field need to be normalized for an apples to apples comparison- e.g. mountain to mountain, climbs vs climbing classes

SHARING WITH LEADERS

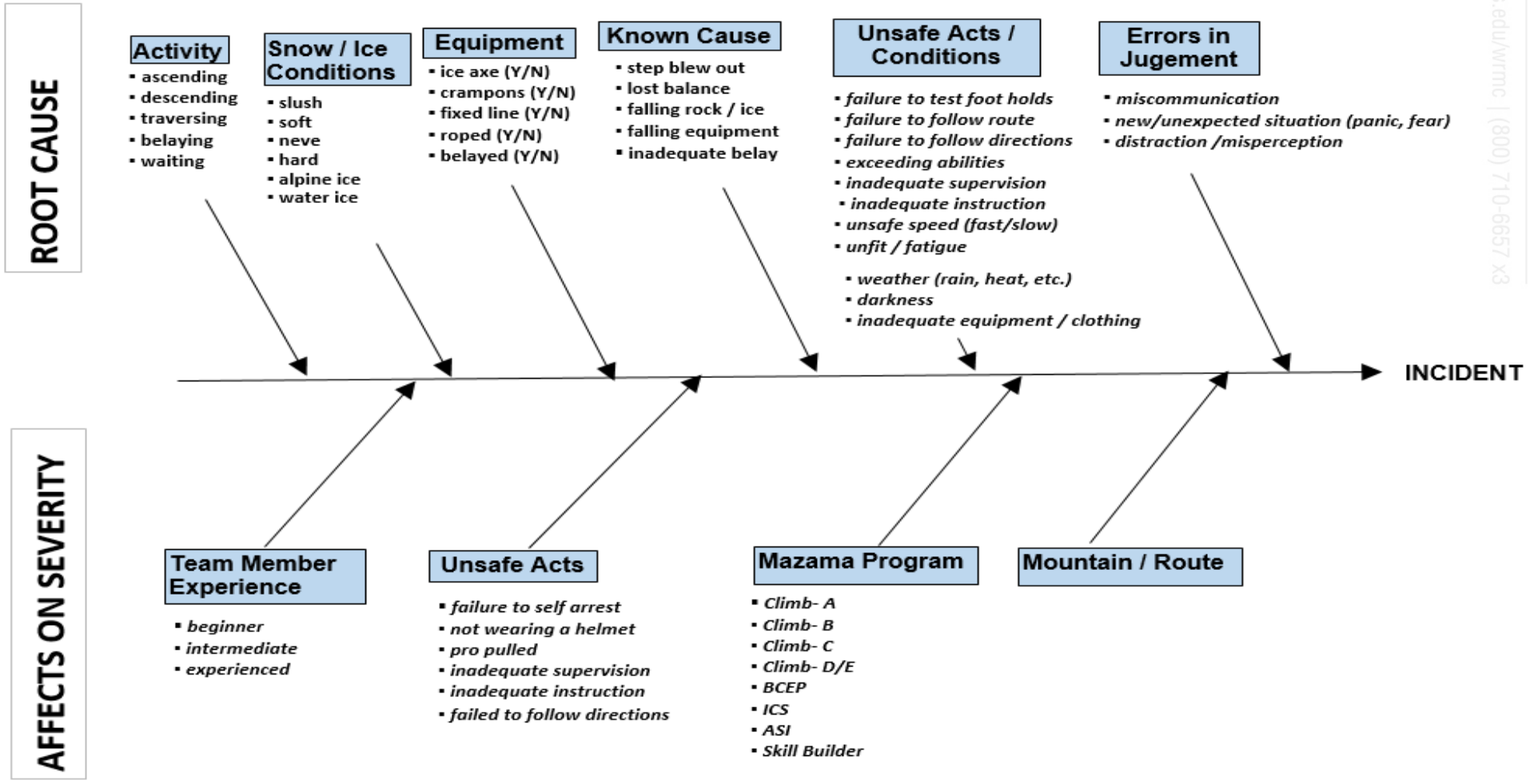
FINDINGS

- Rock fall is the #1 climbing incident
- 77% of rock fall incidents are caused by Mazama party members themselves
- ~38% occur on scree (primarily descending), 42% on 3rd / 4th class (primarily ascending)
- Occurs on B and C climbs with moderate to experienced party members
- No clear contributing causes- 33% are party members not following leader directions, and 25% are party members not paying attention to their position

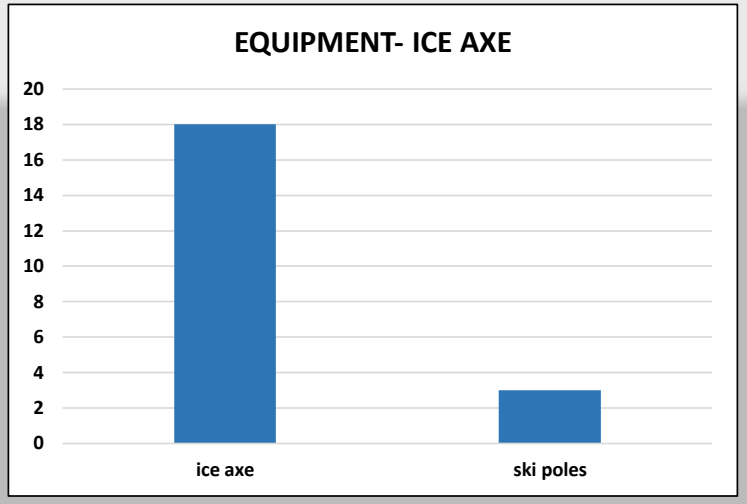
RECOMMENDATIONS

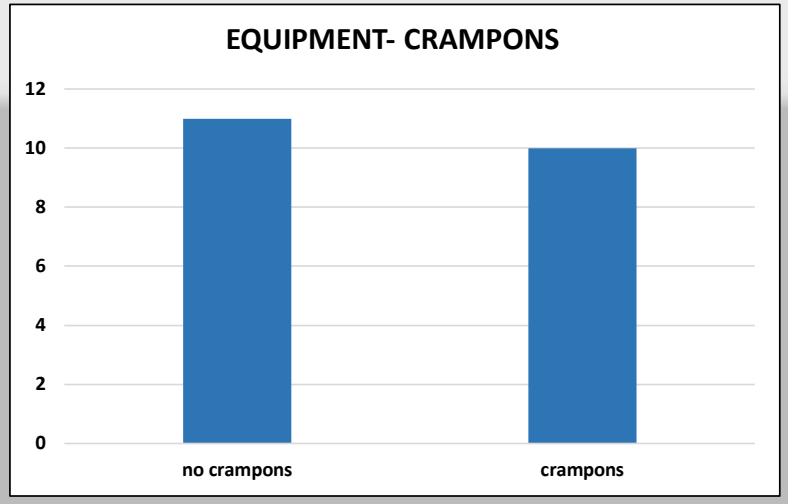
- Ascend / descend narrow gullies and scree 2-3 climbers at a time rather than as a group and use islands of safety for group members below to wait outside the fall line
- Spread out parallel when ascending / descending wide scree fields
- Leaders need to constantly remind team members of potential high rock fall areas
- Individual team members have to have situational awareness of their surroundings- are there people above them or below them?
- Add specific rock fall discussions in both BCEP and ICS curricula

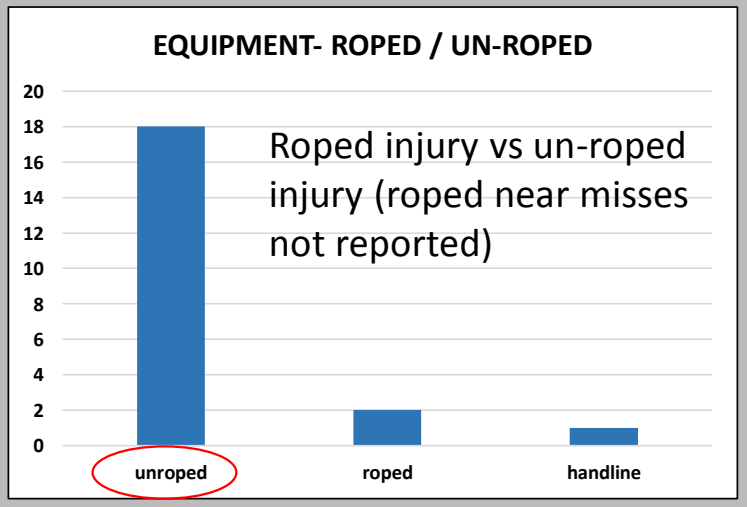
FALLS ON SNOW / ICE (FOLLOWING)

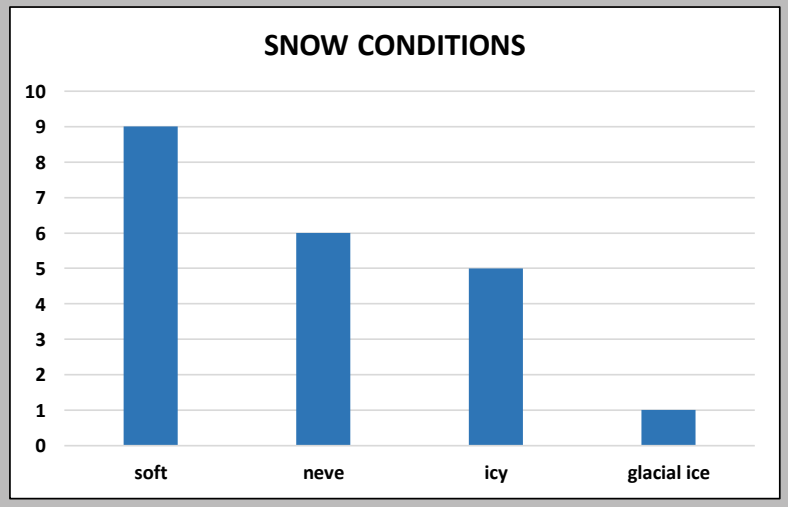


FALLS ON SNOW- COMMONALITY ANALYSIS









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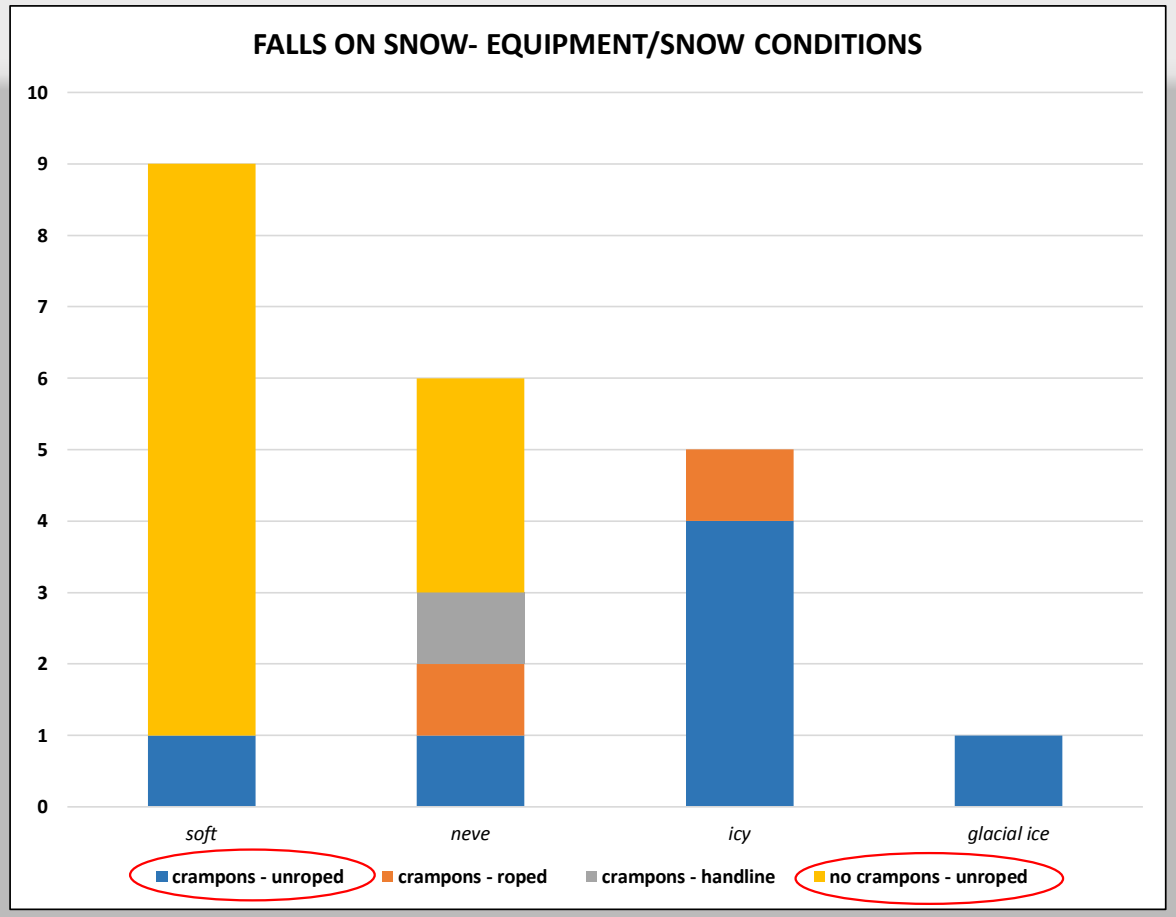

Leader discussions- weighing party member experience and the potential / severity of a fall vs time saved when deciding to rope up and / or wear crampons

Summary of Mazama learnings

INCIDENT / PROBLEM	WHAT WE FOUND	WHAT WE DID
Falling objects (rock)	77% of incidents caused by Mazama party members on scree / scrambling terrain	Involved climb leaders to rethink group management in rock fall environments
Falls on snow	primarily un-roped and/or w/o crampons	Leader discussions- weighing party member experience and the potential / severity of a fall vs time saved when deciding to rope up and / or wear crampons .
Lead falls	Intermediate Sport climbing class 8x higher than actual climbs	Safety review of class- rock gym to outside training
Falls on rock	Primarily un-roped, 50% were failure to test holds	Leader discussions- weighing party member experience and the potential and severity of a fall vs time saved when deciding to rope up on 3rd / 4th class terrain.
Lack of near miss reporting	Near misses < 15% incidents of total reported	leader education of the importance of near miss reporting

Challenges / To Do

- getting leaders to file reports
- trending results with a small data set to see if fixes are working
- customize online incident report by type?

SUMMARY: 3 KEY LEARNINGS

1. Identify top 3 -5 incident types
    - Use a consistent incident definition and adjust reports if necessary
    - Sample size
2. Brainstorm root causes and factors affecting severity
3. Test those causes for commonalities.
    - Share findings and work with your leaders/participants to reduce future occurrences

BRAINSTORMING EXERCISE (20 min)

- Pick an incident type from your organization that you want to understand root causes
- Work by yourself or with others
- Identify your known causes
- Brain storm other possible causes
- Generate a fishbone diagram