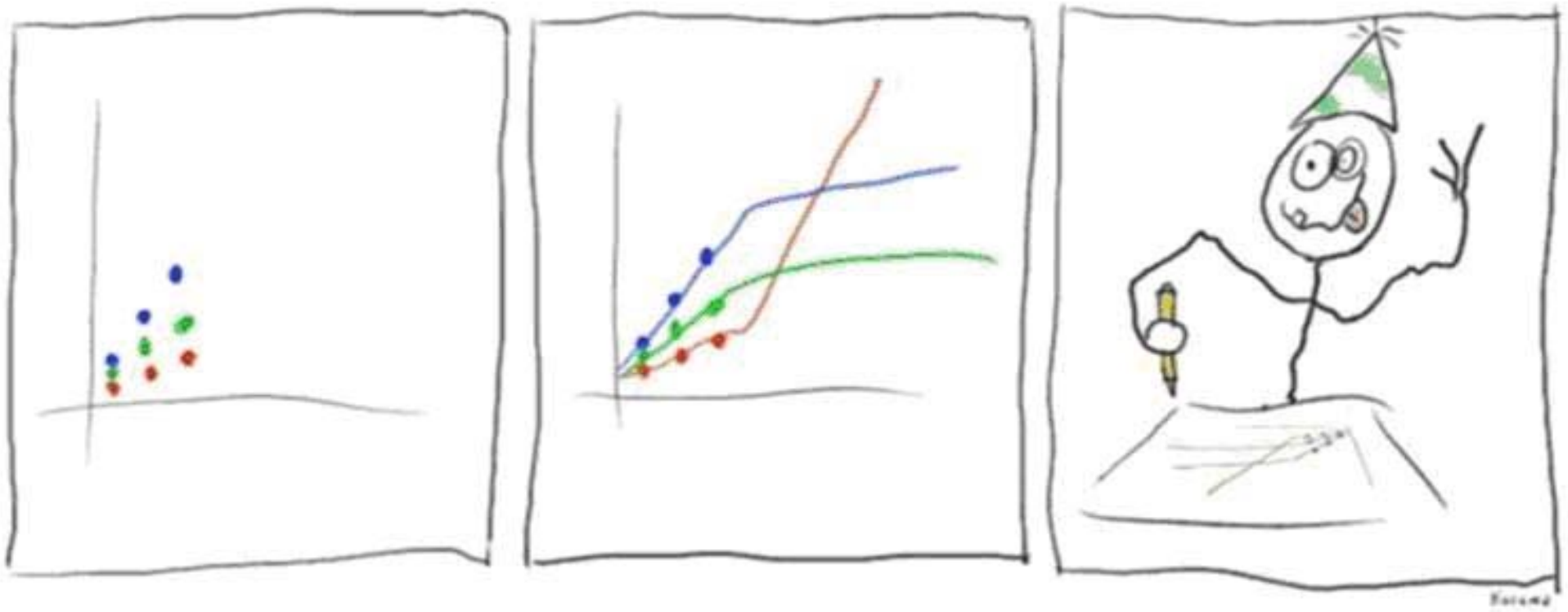
Analysing Vulnerability



Russell Blong

Vulnerability refers to the propensity of exposed elements/attributes such as physical or capital assets as well as human beings and their livelihoods to experience harm and suffer damage or loss when exposed to a hazardous event
(after Adger, 2006; Birkmann et al., 2013)

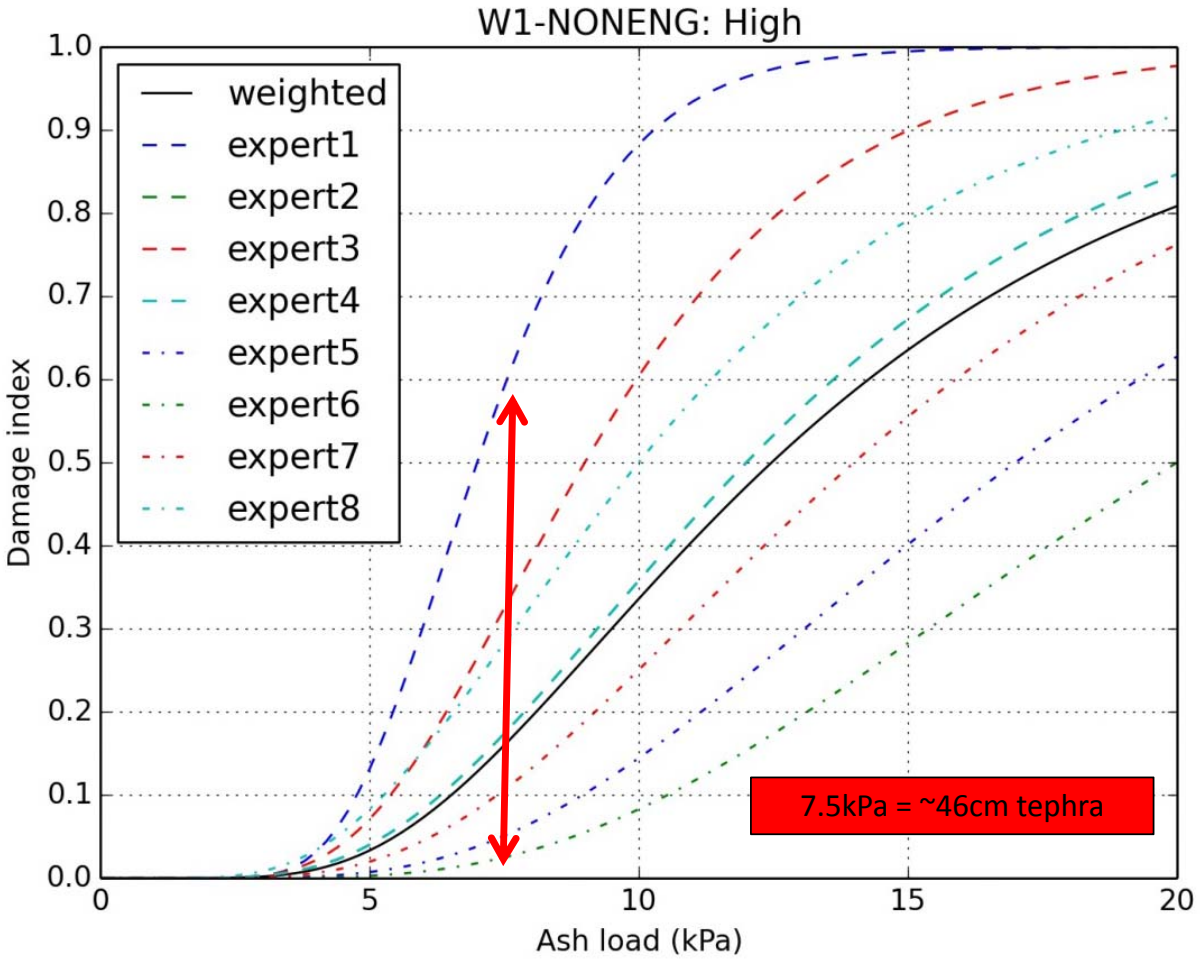
[from a vast, boring, fuzzy, multi-faceted literature]

Pre-event Resilience = 1.0
Replacement Value of the attribute = 1.0
Post-event Resilience = 1.0 – Vulnerability = Remaining Value

Thoughts:

- **No point in getting hung up on definitions (>70 definitions of Resilience – Len Fisher, Nature, 5 Dec 2015, p35)**
- **Hard to know what decision makers want (what do they need to know? - may not know themselves)**
- **Above easy to manipulate for multi-elements – people, buildings, infrastructure, agriculture, other economic …**
- **Have to avoid double counting – can only destroy building, human, or crop once**
- **Focus on a few – prioritise; avoid building a new framework (add to GEM?, GAR?, GFDRR? GRADE?, ….)**
- **We have close to zero data; reliant on expert opinion?**
- **Time frame for vulnerability assessment – immediate/1 year/ 2 year /10 years?**

Digression 1: Ash fall Vulnerability Curves: Art, Not Science.

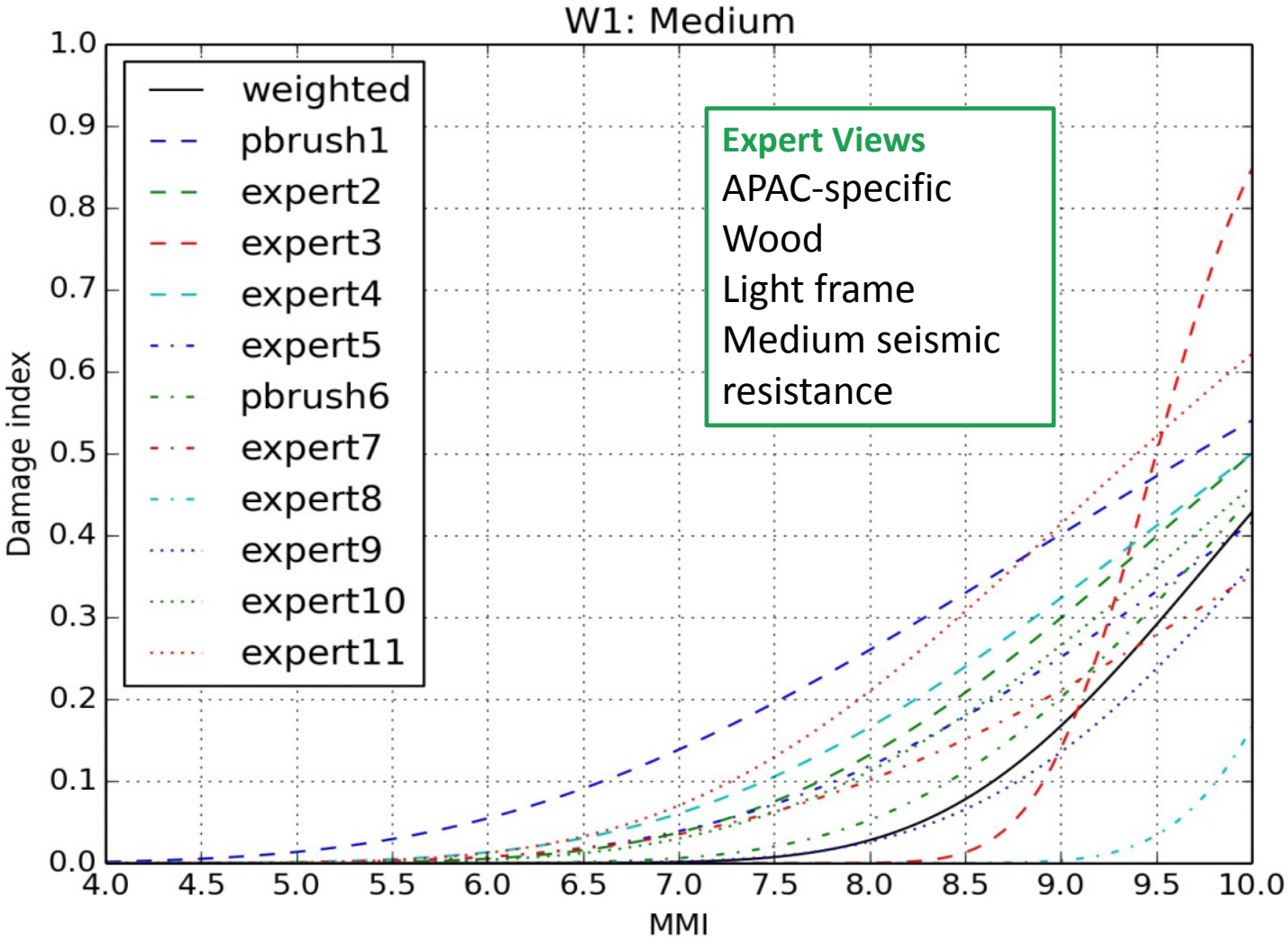


Source: *GAR-15, p519*

W1 – NONENG

- Roof pitch >35^{o}
- APAC specific
- Light timber frame
- Area <5000ft^{2}
- Non-engineered
- 1-2 storey

Digression 2: EQ Loss estimates: GAR Report (2015).



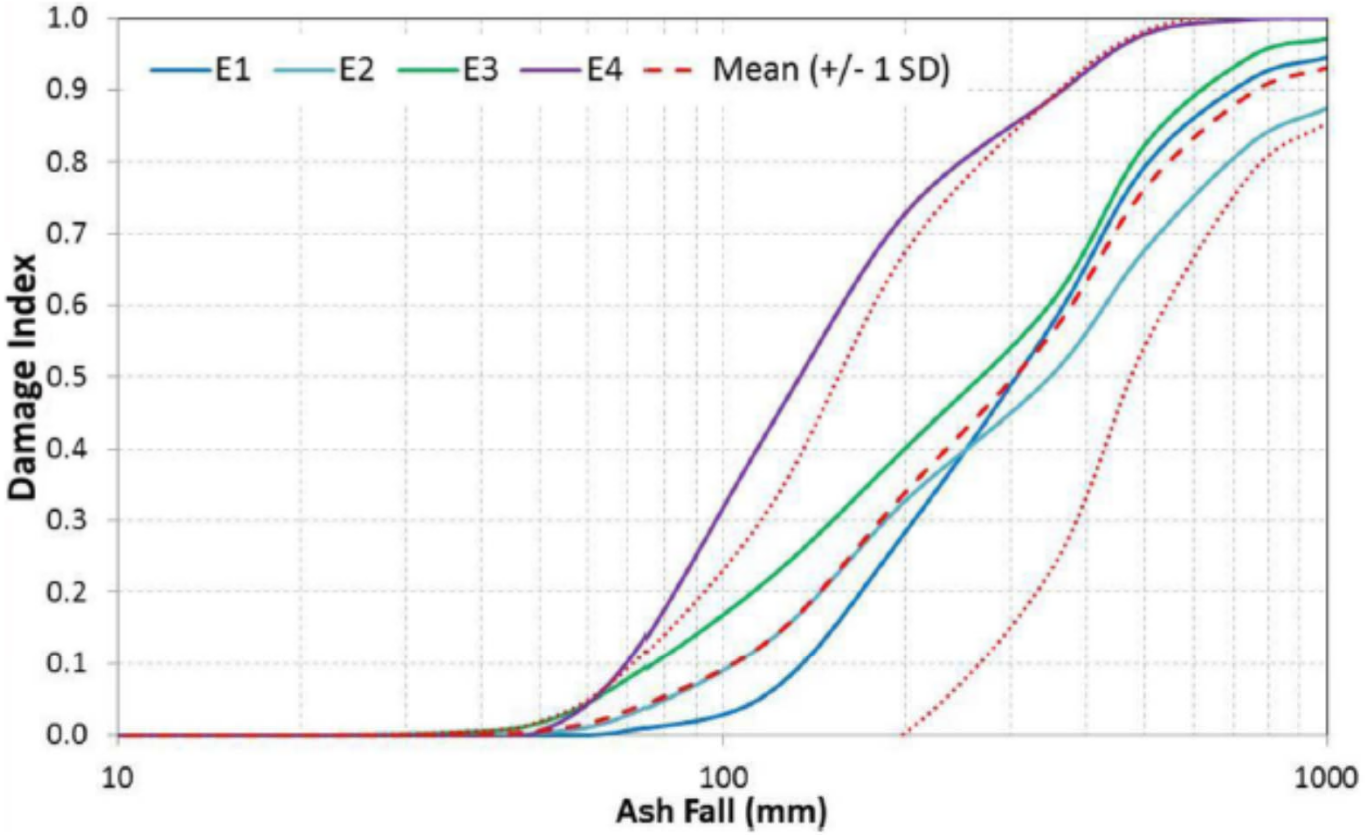
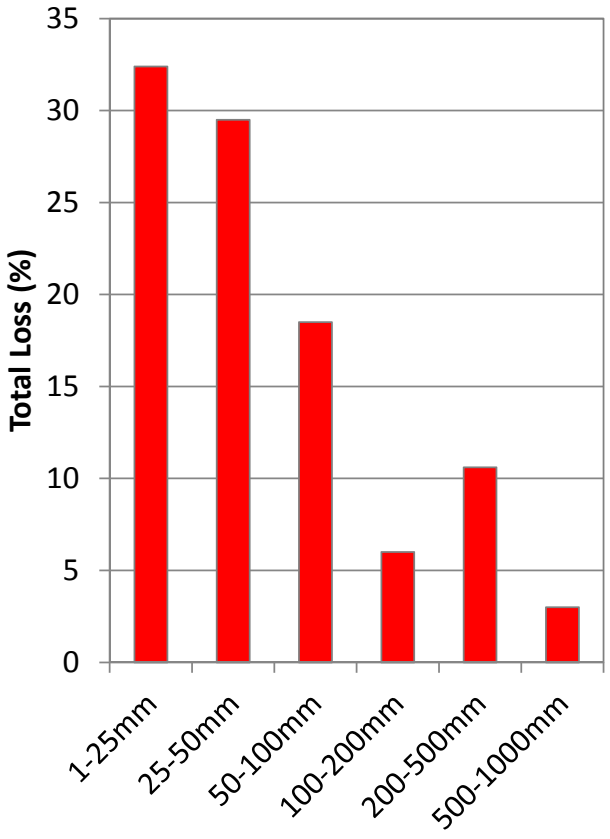


Fig. 9 Damage Index – ash fall thickness relationships for four 'experts'. The dotted lines represent the range of uncertainty (+/− 1 standard deviation) in the mean, highlighting that the greatest uncertainty exists between 800 and 1000 mm ash fall thicknesses; i.e. the range where the majority of the damage occurs (see Fig. 11)

Digression 3: Theoretical Ash fall – loss distribution

- Circular ash fall distribution
- 10 buildings/ha – value $1 m each!

Thickness (mm)	Mean Loss %	Radius (km)	Donut Area (km^2)	Buildings (000s)	Loss $m
1-25	1	29	2,027	2,026.5	$10,132.5
25-50	3	14	462	461.9	$9,238
50-100	5	7	115	115.5	$5,773
100-200	10	3.5	19	18.9	$1,890
200-500	20	2.5	16	16.5	$3,300
500-1000	30	1	3	3.1	$930

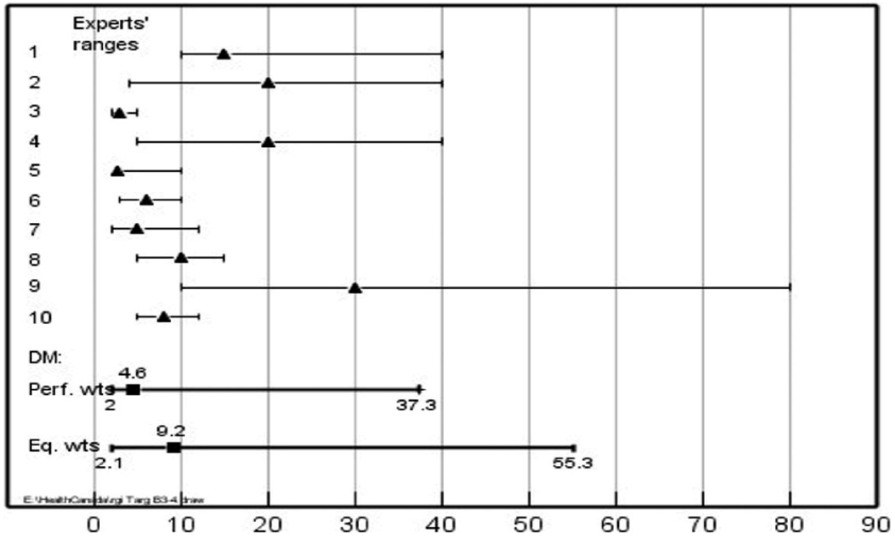


Digression 4: Experts!

"An EXPERT is someone who comes from overseas with a powerpoint and charges you a lot of money to tell you things you knew already in language you can't understand"

(Shiprock, Oregon, 1992)

- Russo and Showmaker (1992): Fewer than 1% of 2,000+ 'Expert' individuals were **NOT** over-confident (using 90% confidence intervals). Only 40-60% of total interval estimates provided by 'experts' contained the true value.



- Expert elicitation: mean incubation period in years for vCJD-infected human by transfusion.

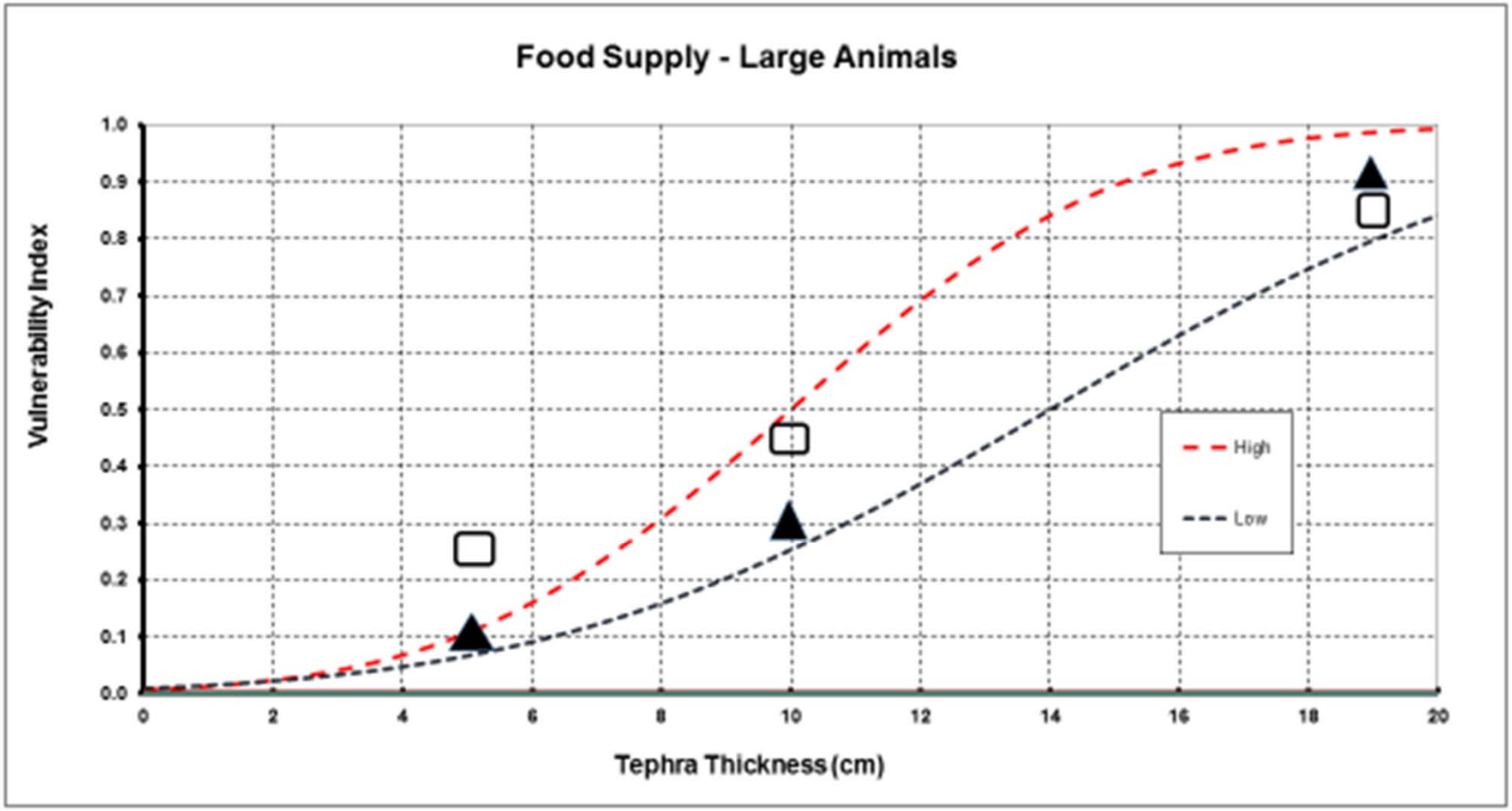
Source: *Jaiswal et al., WCEE, 2012.*

AHP for decision makers?

Importance of four attributes to Federmessergruppen Resilience post-Laacher See ash fall 12 ka

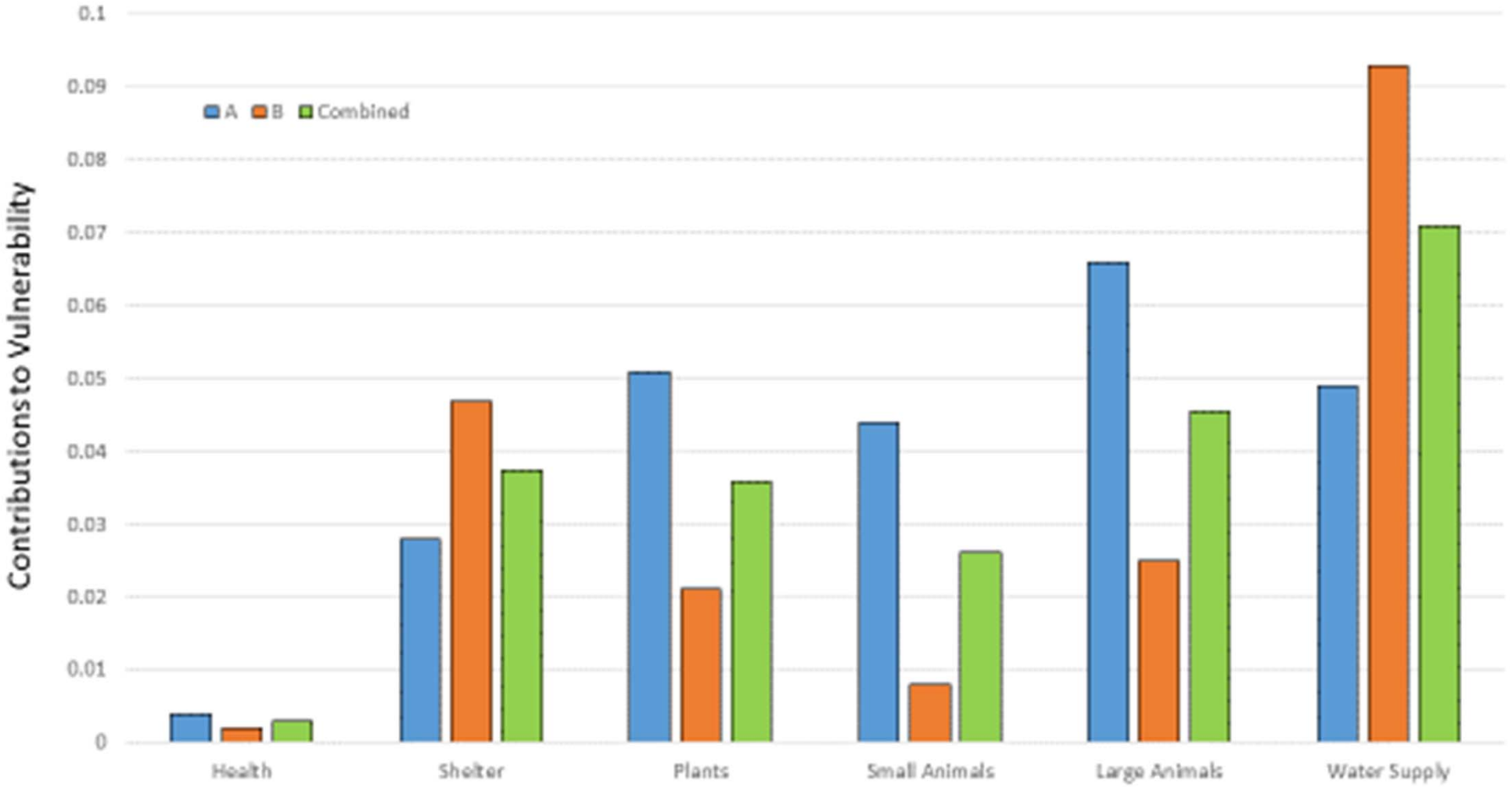
ATTRIBUTE	PARTICIPANT A	PARTICIPANT B	COMBINED RESPONSE
HEALTH	8.8	4.6	6.7
SHELTER	15.7	15.9	15.8
FOOD SUPPLY	48.3	33.0	40.65
WATER SUPPLY	27.2	46.6	36.9
TOTALS	100.0	100.1	100.05

ATTRIBUTE	SUB-ATTRIBUTE	PARTICIPANT A	PARTICIPANT B	COMBINED RESPONSE
SHELTER	Tent-like structures	9.9	12.1	11.0
	Rock overhangs	2.4	2.9	2.65
	Caves	3.4	0.8	2.1
FOOD SUPPLY	Large animals	26.4	25.3	25.85
	Small animals	12.7	2.5	7.6
	Plants	9.2	5.2	7.2



- Omnivorous large animals – wild boar, red and roe deer – eat aerial parts of plants, forbs, fruits + various invertebrates, some carrion, grasses …
- Eye irritation, tooth abrasion, ash ingestion, skin/fur irritation
- Soluble fluorine absorbed on tephra grains
- Seasonal and geographic variations in food supply

FMG Vulnerability – 20 cm tephra fall



Rabaul 1994 (~7.8kN/m^2)

Insurance claim:

- Damage to building
- Debris removal – up to 10% of Sum Insured
- Alternative accommodation – 10% on top of SI
- Professional fees – 10% on top of SI
- Asbestos removal?
- Bring building up to code?
- If building damage >70% SI, probably Total Constructive Loss (i.e. 100%)
- Loss assessors' fees - <10% SI
- Insurer may pay up to total 1.3 times Sum Insured

Hours clause in reinsurance contract:

72 h, 168 h, 672 h – then separate event (influences whether insurer or reinsurer pays)

Raises questions again about what we mean by and how we cost Vulnerability?

EDO Earthquake 1855

「新吉原 大なまずゆらい」「なまずが暴れると地震がくる、こいつさえ退治すれば…
…」そんな俗説を信じ、女郎、太鼓持ちが、大なまずを責め立てる

被災地では異常なる再建ブーム。地震成金と
なった大工や左官にとっては、なまず様々であった
東京大学地震研究所蔵(左も同じ

A Pictorial History of Disasters in Japan, Marine & Fire Insurance Association of Japan, Inc., n.d.