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Using risk comparisons to support natural hazard risk management

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Key messages

- Risk comparisons can be helpful for putting unfamiliar hazards and abstract numbers into familiar contexts.
- If not applied carefully, risk comparisons can be hugely misleading.
- Before risk comparisons are used to inform risk-based decisions, the context of the risk needs to be carefully considered.

Who is this brief for?

Policy professionals and risk practitioners.

Comparing risks fairly

Policymakers and communities often turn to risk comparisons - the act of comparing the risk associated with one activity, hazard, or situation against another - to help put risk into perspective and support decision-making.

But not all risks are directly comparable. How acceptable a risk is depends on its context - including whether it is voluntary or imposed, whether harm happens gradually or all at once, and whether it falls on individuals or on whole communities. Comparing a risk that people choose to take (like driving) with one imposed on an entire community (like an earthquake) is not straightforward; these risks are experienced and managed in very different ways.

Using risk comparisons without considering these differences can lead to poor decisions. A risk threshold that is widely accepted in one setting may be applied to another where that same level of risk is not acceptable. Despite this, there is currently no consistent guidance to help decision-makers check whether a comparison is appropriate before relying on it. This brief sets out a framework to support more careful use of risk comparisons.

Best practice principles

Using the following principles will ensure that risk comparisons are providing meaningful information and do not lead to inappropriate decision-making.

1. Inform and not persuade

Risk comparisons should be used to support understanding, not to influence or steer decisions toward a preferred outcome. Framing risks in a persuasive way can introduce value judgements about what is acceptable or tolerable. Risk comparisons should be used only as one of many inputs into risk-based decision-making.

2. Compare risks with similar contexts

Only risks that are similar in context and characteristics should be compared. If differences in context and characteristics are not accounted for, comparisons may lead to decisions that do not reflect how risks are actually understood or accepted.

Before comparing risks, make sure they align as closely as possible (see page 4 for a list of relevant dimensions). If they don't, and a comparison is still useful, clearly explain how the risks differ and how those differences may affect how they are perceived.

3. Use relevant metrics

Risk comparisons should reflect what matters most to decision-makers and communities, as these values directly shape risk tolerance. Different metrics, such as life safety risk, economic losses, and job losses, highlight different impacts and can lead to different conclusions about what is acceptable. Clearly identify what is most valued by the affected parties and select metrics that align with those priorities.

4. Use consistent metrics

Risk comparisons are only meaningful when measured on a like-for-like basis. If units, timeframes, or geographic scales are inconsistent, comparisons can be misleading and lead to poor or misinformed decisions. To support sound decision-making, risks should be compared using the same units (e.g. annual probability), the same time horizon (e.g. per year or over 30 years), and the same geographic scale (e.g. district or region).

5. Be transparent about uncertainty

Presenting risk comparisons as a single number can create a false sense of precision and lead decision-makers to place more confidence in the result than is warranted. Instead, present ranges, confidence levels, and key assumptions so decision-makers can understand the level of uncertainty and make more informed, balanced decisions.

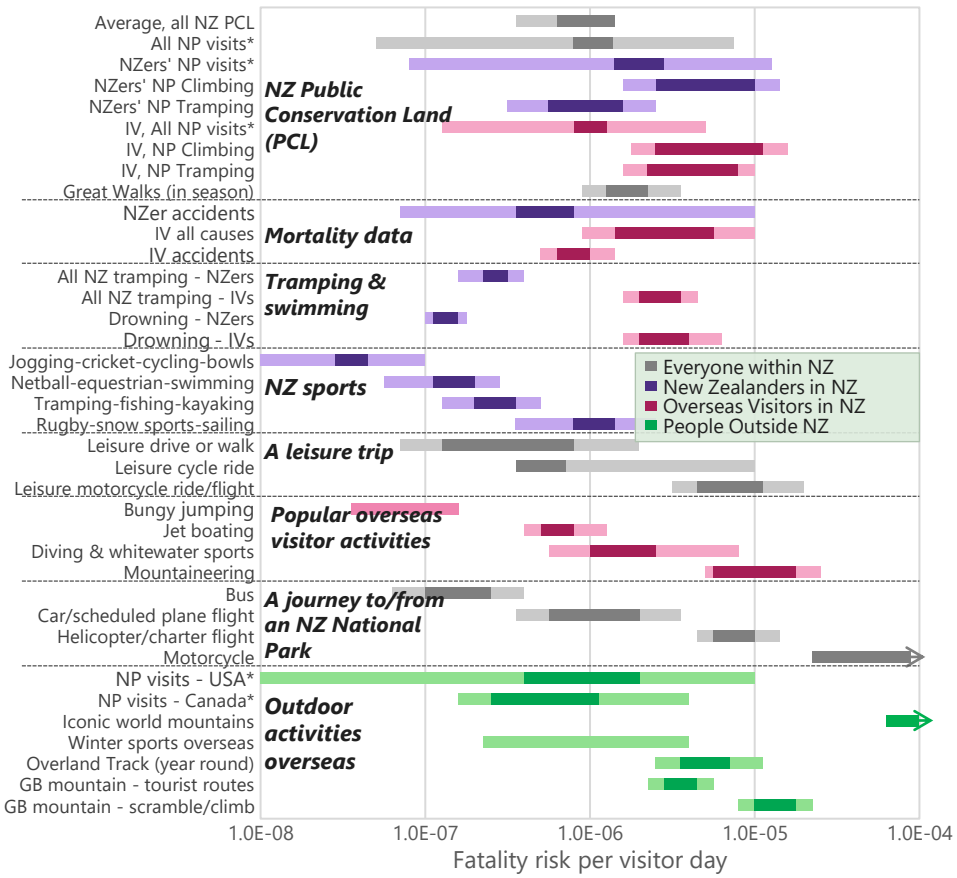
CASE STUDY:
Risk comparisons done well

The Department of Conservation (DOC) used risk comparisons to establish agreed thresholds for risk to life across different visitor groups and at various DOC sites across the country. These thresholds enable consistent risk management and help ensure resources are used effectively, avoiding both under- and over-management.

DOC's approach demonstrates several elements of best practice in applying risk comparisons:

- Risks are not compared between staff and visitors, recognising the different nature of voluntary risk exposure in each group.
- Separate metrics are also used for each group: visitor risk is measured as the fatality risk per visitor-day, while staff risk is assessed as the annual individual fatality risk.
- Visitor groups are also differentiated to reflect varying risk tolerance levels. For example, backcountry adventurers are likely to accept higher risks than short-stop or day visitors.
- Accounting for different risk tolerances as part of risk comparisons ensures that similar groups are being compared and thresholds that reflect risk tolerances are developed.
- Highly accessible sites are managed to have low risk, while remote sites have higher risk and less management.
- A range of parameters inform its thresholds. These include observed fatality risks on public conservation land, risks associated with travel to and from sites, and risks from comparable sport and recreational activities. Comparing similar activities ensures that relevant factors are appropriately accounted for, supporting more robust and credible risk thresholds.

Summary of Individual Fatality Risk for DOC Visitors and Comparators



Notes: *IV = International Visitor, NZer = New Zealand resident; see text for details & assumptions.*
** Ranges from lowest to highest risk park; other NZ PCL figures are averages over all parks/walks*

Figure source: Taig, T. (2022). Risk Comparisons for DOC visitors and workers.

Policy and sector recommendations

- ✓ Apply these principles whenever you use risk comparisons.
- ✓ Use risk comparisons as part of a wider move to embed explicit risk tolerance considerations in risk-based decision-making.
- ✓ Use risk comparisons to support alignment of risk management across agencies – where contexts are comparable.

Examples of risk comparisons (good and bad)

WHEN COMPARING NATURAL HAZARD RISKS, COMPARE LIKE FOR LIKE

For example, all of the following could be compared on the basis that they all represent:
Involuntary exposure Limited control Potential for catastrophic impact Societal consequences

Flash flooding
Sudden onset, limited warning, involuntary, with community-scale impacts.

Landslides
Rapid onset, little warning, involuntary, severe impacts on community and infrastructure.

Tsunami
Sudden onset, limited warning, involuntary, with widespread coastal community impacts.

Public health
(e.g. pandemic)
Population-wide exposure with potential for rapid escalation and system-wide impacts.

Space weather
System-wide, societal-scale impacts on power and communications infrastructure.

Climate change
Societal-scale impacts with intergenerational effects and distributional consequences.

Always ensure risks are compared on a like-for-like basis (same units, timeframe, and scale) and be transparent about assumptions and uncertainty.

EXAMPLES OF WHAT TO AVOID

Driving
Voluntary, familiar, individually controlled.

Smoking
Voluntary, chronic, individual.

Household accidents
Small-scale, low consequence.

Everyday health risks
Not catastrophic, individual.

Further reading

Das M., Doyle E.E.H., Potter S.H., Charlton D.H., Becker J.S., Vinnell L., Leonard G.S., Johnston D.M. (2025). Guidelines for communicating likelihood and probability of natural hazards. Lower Hutt (NZ): Earth Sciences New Zealand. (GNS Science report; 2025/29).

Hudson-Doyle, E.E., Brown, C. (2026). Why risk tolerance matters: improving natural hazard risk decisions across policy and practice, Policy Brief #1, Risk Tolerance Working Group www.resorgs.org.nz/wp-content/uploads/RTWG_policy_brief_why_risk_tolerance_matters.pdf

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Sandman, P. M. (1988). Risk communication, risk statistics, and risk comparisons: A manual for plant managers (Part III). Chemical Manufacturers Association. psandman.com/articles/cma-3.htm

U.S. Nuclear Regulatory Commission. (2004). The Technical Basis for the NRC's Guidelines for External Risk Communication. NUREG/CR-6840. nrc.gov/docs/ML0405/ML040540526.pdf

Risk comparisons help people make sense of unfamiliar risks. When being used to support decisions making care must be taking when comparing risks across different contexts.

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DEVELOPING AND SHARING KNOWLEDGE

APPENDIX: Contextual dimensions

The following is based on a set of psychometric dimensions found to affect how people perceive and tolerate risks.

Dimension	Definition	Example Variation Across Hazards
Voluntariness	Whether people are exposed to the risk by choice or have it imposed on them.	Skydiving (highly voluntary) vs. nuclear power plant emissions or air pollution (involuntary).
Immediacy of effect	Whether harm appears quickly after exposure or is delayed in time.	Storms/car crashes (immediate) vs. asbestos, radiation, or smoking (delayed onset over years).
Knowledge to exposed	How well the risk is understood by the people who face it.	Driving (well known to drivers) vs. food additives or pesticides (poorly known to consumers).
Knowledge to science	How well the risk is understood by experts and the scientific community.	Storms/falls (well characterized scientifically) vs. genetic engineering, novel chemicals, or emerging pathogens (low scientific understanding).
Controllability	The degree to which an individual can personally reduce or avoid the risk through their own actions.	Driving or home accidents (high personal control) vs. nuclear accidents or commercial aviation (low personal control).
Newness vs familiarity	Whether the hazard is novel and unfamiliar or longstanding and familiar.	Fire, drowning (old, familiar) vs. AI systems, nanotechnology, CRISPR (new, unfamiliar).
Chronic vs catastrophic	Whether impacts are spread over time or are concentrated in a single event.	Smoking, car accidents (chronic, distributed) vs. nuclear accidents, plane crashes, dam failures (catastrophic, concentrated).
Dread	Degree of fear, terror, or visceral aversion the hazard evokes, beyond statistical harm.	Storms, household accidents (low dread) vs. nuclear power, terrorism, nerve gas (extremely high dread).
Severity of consequences	How certain it is that exposure leads to fatal or catastrophic outcomes.	Sunburn, minor falls (rarely fatal) vs. nuclear weapons, Ebola (near-certain fatality if exposed).
Number of people exposed	The scale of population that could be affected.	A specific occupational hazard (small group) vs. climate change or nuclear fallout (millions or billions).
Personal exposure	Whether the individual perceives themselves to be personally at risk.	Coal mining (only miners) vs. air pollution or pandemics (everyone).
Effect on future generations	Whether harm is confined to those currently exposed or extends to descendants.	Storms, traffic accidents (current generation only) vs. radioactive waste, climate change, genetic damage (multi-generational).
Ease of reduction	How readily the risk can be lowered through known interventions.	Seatbelts/helmets (easy mitigation) vs. nuclear waste storage, climate change (extremely difficult to reduce).
Risk trend	Whether the perceived risk level is rising or falling over time.	Smallpox, polio (decreasing) vs. cyber-attacks, antibiotic resistance, AI risks (increasing).
Observability	Whether the risk and its effects are visible/detectable or hidden.	Storms, fires (highly observable) vs. radon, carbon monoxide, radiation (invisible, undetectable without instruments).
Equity or fairness of distribution	Whether benefits and risks are distributed fairly among those affected.	Driving (drivers benefit and bear risk) vs. nuclear plants or polluting factories (locals bear risk; broad population gets benefit).
Trust in institutions	Confidence that authorities managing the risk are competent and honest.	Routine medicine (often high trust) vs. nuclear regulators, chemical industry, biotech firms (often low public trust).
Reversibility	Whether harmful effects can be undone.	Bone fractures, minor poisoning (reversible) vs. extinction, genetic mutation, climate tipping points (irreversible).
Catastrophic potential	The maximum possible scale of harm in a worst-case event.	Storms (bounded local damage) vs. nuclear plants, asteroid impact, pandemics (potential for civilizational harm).