

# NZSAR Fatality Study

New Zealand Search and Rescue



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## Executive Summary

Whitireia New Zealand were contracted by New Zealand Search and Rescue (NZSAR) to analyse their fatality data recorded for the period between April 2010 and July 2017. Firstly, the database was cleaned to allow meaningful analysis. Cases were initially divided into six prescribed categories:

1. Land
2. Water
3. Wanderer (children, people with dementia, etc.)
4. No incident/false alarm
5. Out-of-scope: suicide, criminal, disaster victim identification (DVI), aviation, outside of SAR region
6. Uncertain – for cases that did not clearly fit into one of the above.

Events categorised as ‘uncertain’, were then discussed by the team in order to establish categorisation by consensus. The 72 cases that could not be categorised due to a lack of information were then referred back to the study’s NZSAR liaison. NZSAR made the decision to exclude these cases from the analysis due to a lack of accurate information.

Following categorisation, demographic and thematic analyses were completed on each category, creating a demographic profile of victims while identifying trends and patterns from the narrative descriptions. Land, Water and Wanderer fatalities were considered to be within scope, and were the subject of full analysis. Categories four and five (suicide, criminal, DVI, aviation, out-of-region and no incident) were considered out-of-scope but were still the subject of full demographic analysis and partial thematic analysis, where the data allowed.

### Land

Land-based activities resulted in 194 fatalities. Five activities were most frequently associated with death and accounted for 75% of the land-based fatalities. They were:

1. Tramping (29%)
2. Hunting (15%)
3. Walking (12%)
4. Mountaineering (11%)
5. Commercial (8%)

Three mechanisms of death accounted for 81% of the Land-based fatalities. They were:

1. Falls (31%)
2. Drowned (26%)
3. Medical (24%)

### Recommendations

- Consider buoyancy devices when engaged in activities where a fall into the water is possible (rocks, mouth or bank of river, in tidal waters)
- Education around falls prevention, targeting tramping and mountaineering clubs

## Water

Water-based activities resulted in 320 fatalities. Three sub-categories resulted in 79% of deaths:

1. Boating (30%)
2. Commercial (27%)
3. Swimming (22%)

Attempts to breakdown the mechanism of death was less useful in this category due to difficulties confirming the actual cause and because drowning was almost always the final result. Contributing factors included:

- Being swept out to sea
- Lack of a buoyancy device
- Alcohol or drug use
- Medical
- Jumping

### *Recommendations*

- Wear a buoyancy device when engaged in activities where falling into the water, or being swept away, are possibilities (boating, net setting, fishing)
- Consider issuing an emergency position indicating radio beacon (EPIRB) to each person on board a vessel, to be worn at all times
- Specifically target the Māori and Pacific communities in relation to water safety

## Wanderers

Eleven people died as a result of wandering incidents and were split into two distinct cohorts; children (45%) and the elderly (55%). Drowning was the mechanism of death for four of the five children (80%) and three of the six adults (50%).

### *Recommendations*

- Immediate water hazards, including those thought to be secure, should be a priority for searchers.

## Out-of-scope activities

This category accounted for 452 deaths, suicides (41%) and DVI cases (40%) being the two most common.

## Non-events

The majority of non-events were water-based (86%) and most of these were activations based on members of the public reporting a flare sighting.

### *Recommendations*

- Create an educational awareness programme to advise the public on how to correctly identify a flare and how to react.

## Conclusions.

The data highlights the importance of buoyancy devices whilst undertaking both water and land-based activities, including net-setting and fishing from rocks. Immediate water hazards are associated with wanderer fatalities, while falls and slips are associated with land-based fatalities. While the database was incomplete, with missing data skewing all analyses, the data suggests that significant fatality rates are present for Māori and Pacific peoples in water recreation, and that water safety advice should be targeted towards these specific populations.

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## Introduction

The New Zealand Search and Rescue (NZSAR) Secretariat provides a link between the operational and strategic roles of New Zealand Search and Rescue. They support and advise the NZSAR Council who in turn provide high level oversight. They also provide leadership to the NZSAR Consultative Committee; this committee comprises of a wide range of NZSAR stakeholders including the Rescue Coordination Centre (RCC) and NZ Police.

This report has been commissioned by the New Zealand Search and Rescue Secretariat (NZSAR Secretariat) to review all NZSAR related fatalities (or presumed) from 2010 to mid-2017.

The purpose is to provide;

- A high level overview of all fatalities;
- An analysis of in-scope recreational fatalities;
- Recommendations for prevention messaging if appropriate

Recreational cases were divided into 'land', 'water' and 'wanderer'. Out-of-scope cases included suicides, criminal, body recover or disaster victim identification (DVI), aviation, commercial and those occurring outside the NZSAR region.

The database received by the study team contained approximately forty three fields, many of which were completed sporadically. Two fields provided a narrative of the event; this ranged in detail from an empty field (no narrative at all) to 2000 word descriptions that had computer code interspersed throughout. Significant time was spent cleaning this data.

Next, an iterative re-categorisation process took place. Initially the 'not located' or 'no SAR required' cases were excluded (although a high level overview is included). The located fatalities (988 cases) were then categorised by activity using a coding system, which indicated whether they were in-scope or out-of-scope. The next stage involved assessing the in-scope fatalities (430 cases) for sub-activities, cause of death and associated trends. Out-of-scope fatalities (452 cases) were sub-categorised by cause with a high level overview provided.

### Terminology

It should be noted that the terminology used throughout the report, especially in relation to ethnicity and behaviour, were a reflection of the data labels used within the database. Terminology such as 'Polynesian', 'Caucasian' and 'NZ Caucasian' are at best unhelpful when extracting meaningful ethnicity data, and therefore would urge the NZSAR to take guidance from Statistics New Zealand for terminology around ethnicity coding (see Database section) in future iterations of the database.

A common term used to describe the demographic data was 'no correct data'. This involved fields which were empty and where the information presented was unclear. For example, if three genders or three ethnicities were provided and only one fatality occurred, the study team were unable to determine an accurate gender or ethnicity of the victim. The team used database narratives and publicly available sources in an attempt to consolidate the data, although confirming data definitively using coronial reports was beyond the scope of the agreement. NZSAR requested reasonable assumptions to be made regarding specific information where appropriate.

## Database irregularities

The database had not been comprehensively completed, resulting in a large amount of missing data. Seventy two events, representing 7% of located fatalities were excluded from the analysis following consultation with NZSAR due to missing data.

Not every field was relevant for each case (e.g. boat length isn't relevant for a wanderer or a trampler), and there was no distinction between fields that were left intentionally or unintentionally blank. The number of deaths associated with a case often didn't match the demographic data and consequently large portions of the demographic statistics for the 'water' category are unknown. Refresher training in database completion for all NZSAR staff may help improve data quality.

## Case Categorisation

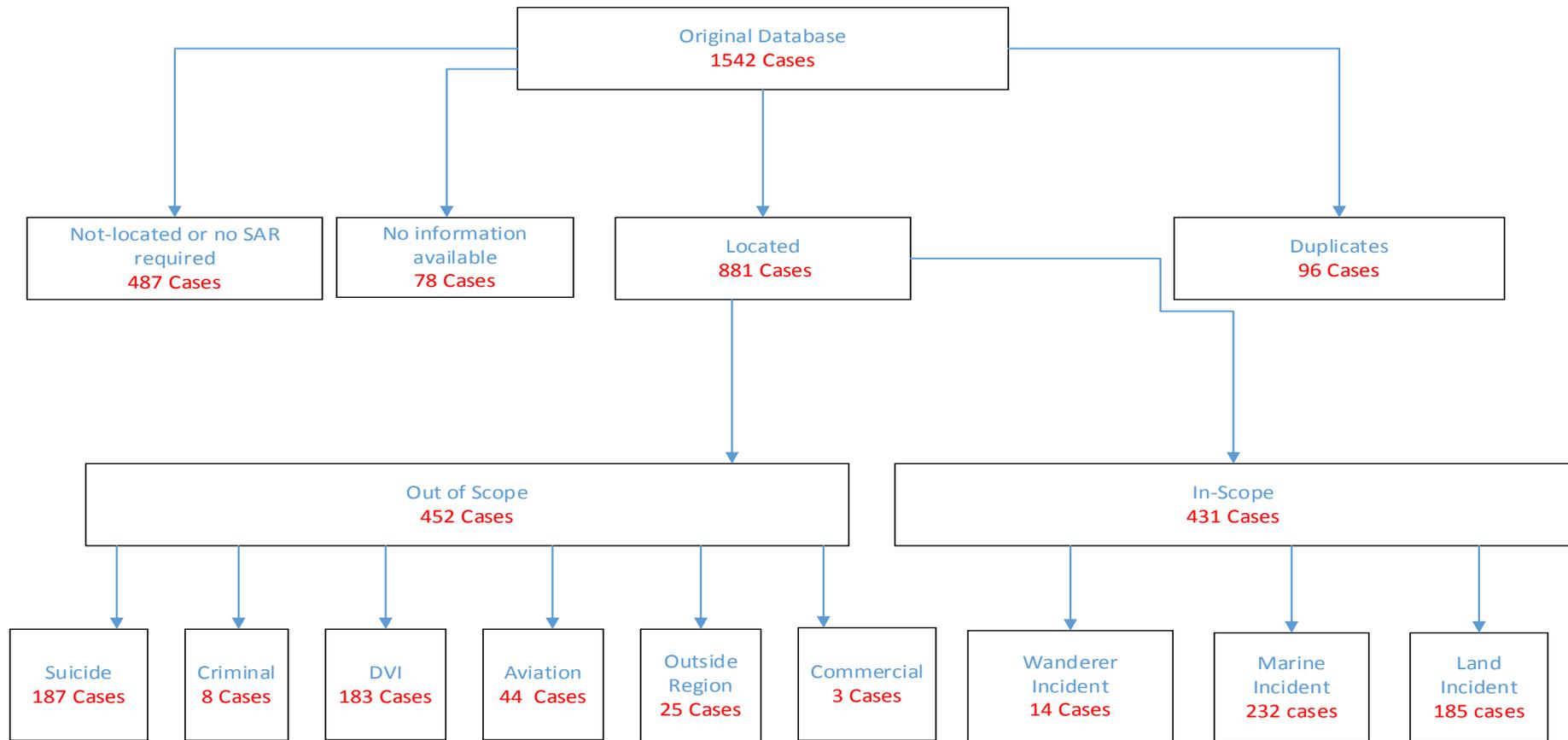


Figure 1: Case Categorisation and Exclusions (in-scope, out-of-scope)

This diagram (figure 1) provides a high level overview of the supplied database in its raw form through to the different categories created by the study team. Analysis was focused on the 'in-scope' cases and an overview provided of the out-of-scope and not located categories.

## Located Fatality Demographics

### Located Fatalities by Gender

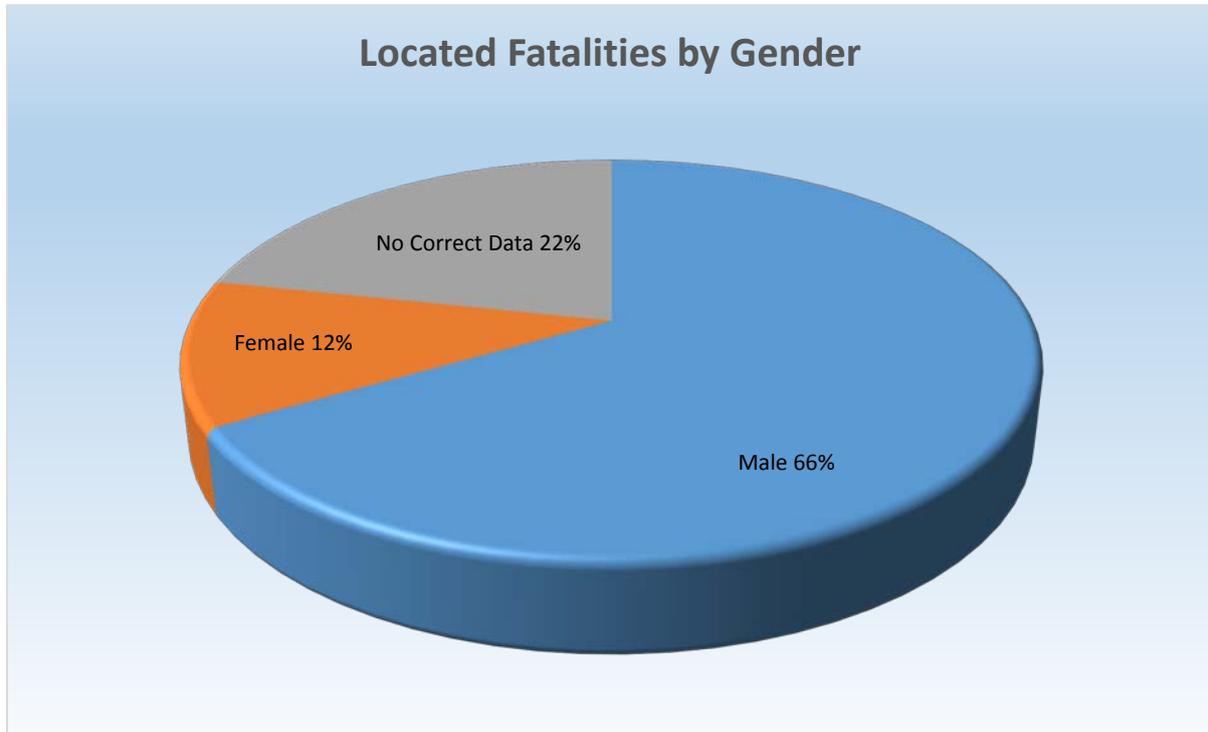


Figure 2: Located Fatalities by Gender

At least 66% of all located fatalities in the NZSAR database were male (figure 2), comprised of 881 cases and 975 deaths. Extrapolating this figure from the known data is likely to produce a male fatality rate of more than 80%. As noted above, missing data has created difficulty in extracting meaningful analysis.

#### Gender Recommendations

Gender-based information can be collected as 'sex' or 'gender', depending on the requirements of the organisation (StatsNZ, 2017b).

"Sex is the distinction between males and females based on the biological differences in sexual characteristics, whereas gender identity is how you experience gender internally." (StatsNZ, 2017b)

The suggested terms for gender identity include:

1. Male
2. Female
3. Gender diverse

If preferred this can be broken down further, however in the interests of gaining high compliance for completion these terms are not recommended for this database.

## Located Fatalities by Ethnicity

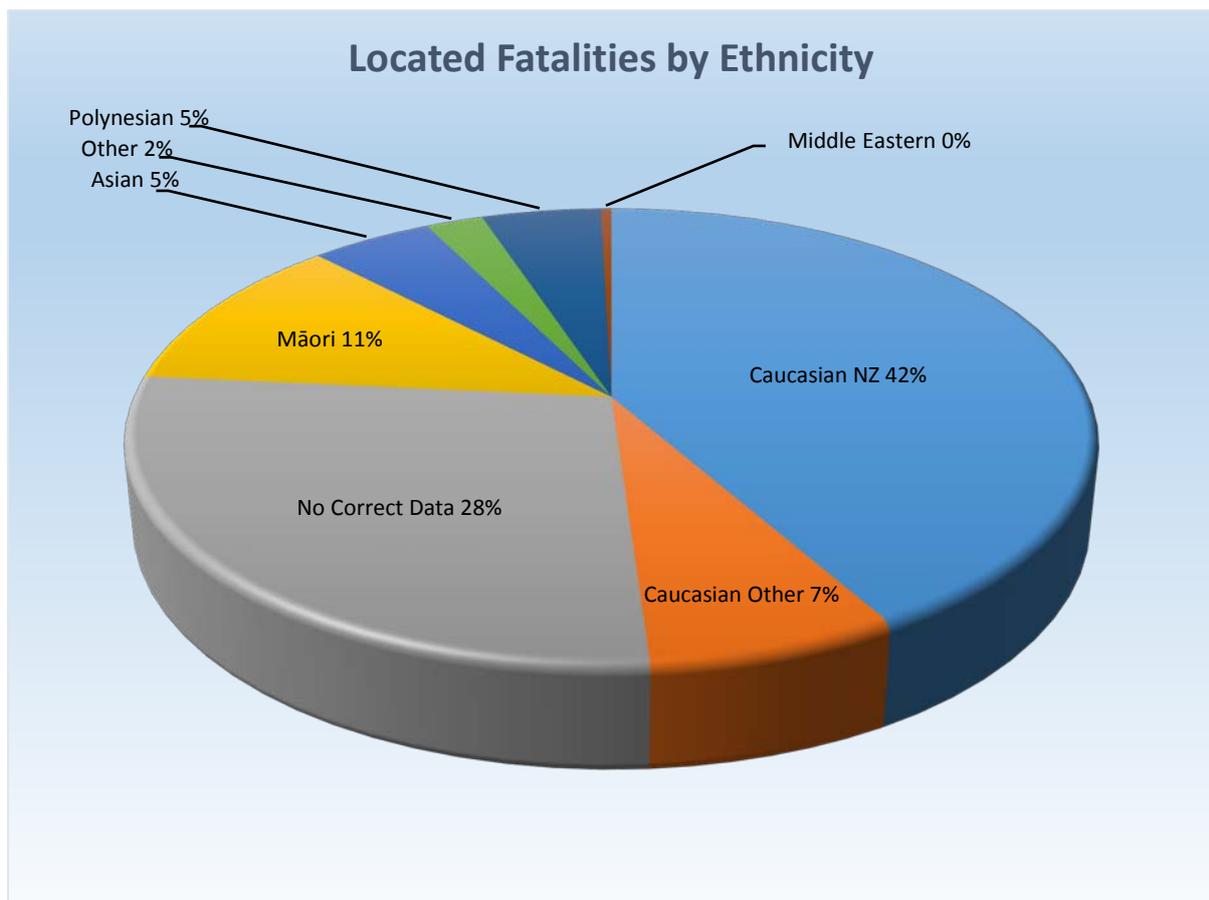


Figure 3: Located Fatalities by Ethnicity

Meaningful ethnicity data is difficult to ascertain as every ethnicity is essentially under-represented due to nearly 30% of the cases containing missing data (figure 3). The terms used within the database cannot be found in any official New Zealand publication, therefore the following changes are suggested below, developed and recommended by Statistics NZ in line with accepted terminology.

### *Ethnicity Recommendations*

A balance is required between gathering meaningful data and enabling high compliance with data capture. If all ethnic groups represented, then over one hundred options would be available. Statistics NZ captures five major ethnic groups which may be a suggested approach for this database (StatsNZ, 2017a). These groups are:

- European
- Māori
- Asian
- Pacific peoples
- Middle Eastern/Latin American/African (MELAA)

If the purpose is to identify broad trends and to influence public messaging, broad, manageable and appropriate ethnicity data would provide the most benefit.

## Located Fatalities by Age



Figure 4: Located Fatalities by Age

It is interesting to note that while there is a spike in the general trend around late adolescence, the highest proportion of fatalities occur in the 50-64 year age group (figure 4). This may reflect increased free time, fewer dependants, increased health concerns, interest in cultural activities and financial ability to partake in outdoor pursuits.

### Age Recommendations

- Messaging should broadly target all age groups, with specific reference to men in early and late middle age.
- Nearly 30% of age related data was missing or incomplete. A forced single response 'age per fatality' should be required to ensure accurate data.

### In-Scope Fatalities by Year

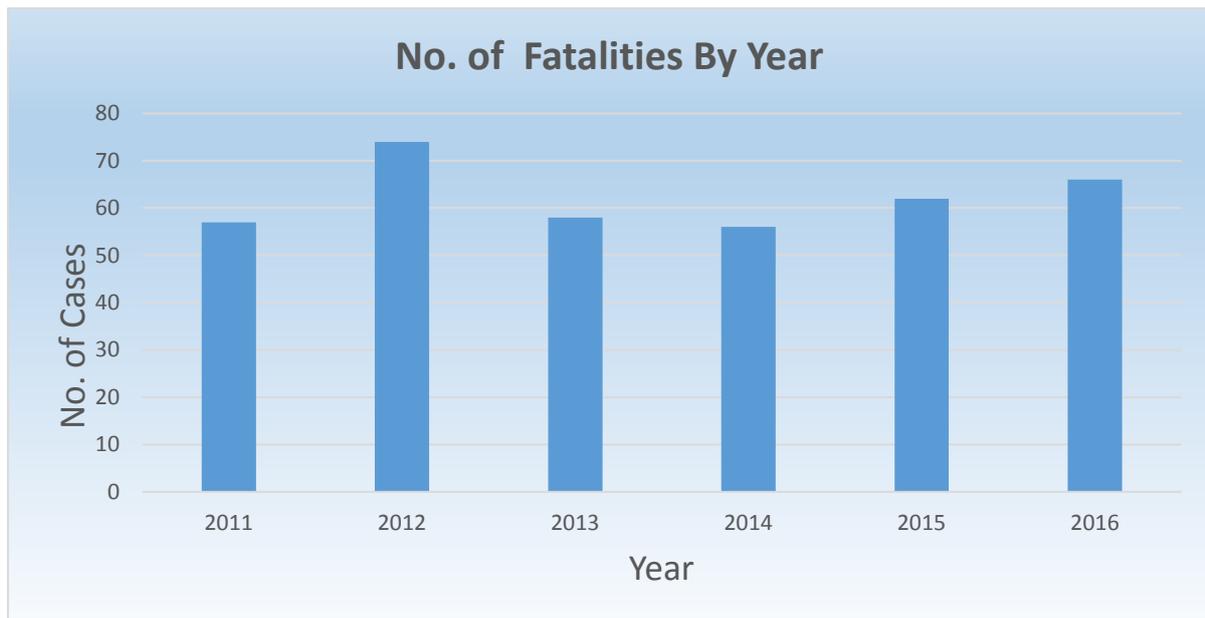


Figure 5: No. of In-scope Fatalities by Year

The number of fatalities by year is relatively consistent and there is no significant trend towards an annual increase or decrease in deaths (figure 5). It should be noted that data presented for both 2010 and 2017 contains only part-year data, with data projections broadly in keeping with the other years.

### In-Scope Fatalities by Month



Figure 6: No. of In-Scope Fatalities by Month from mid-2010 to mid-2017

There is a clear increase in fatalities in the warmer months of the year, presumably due to an increase in participation during this time (figure 6). All land, water and wanderer deaths were included.

## Land-based activities

This section relates to deaths that occurred while the victims were *intentionally* engaged in land-based activity. For example, a person who intended to walk along a riverbank, slipped into the water and drowned would be included in this category, because their primary intention was walking (despite the fact that the cause of death was drowning). Similarly, a person who was walking, but then entered the water while attempting to rescue someone else and drowned would also be included in this category, as the primary intention of the victim had been recreational walking.

The majority of the deceased were engaged in walking activities such as: a multi-day tramping; day walks; dog walking; exploring coastal rocks (or similar) or fishing from land. In the case of those walking across rocks, the main cause of death was drowning after the victims were swept off the rocks by a large wave or slipped and fell into the water.

## Land Fatalities by Location

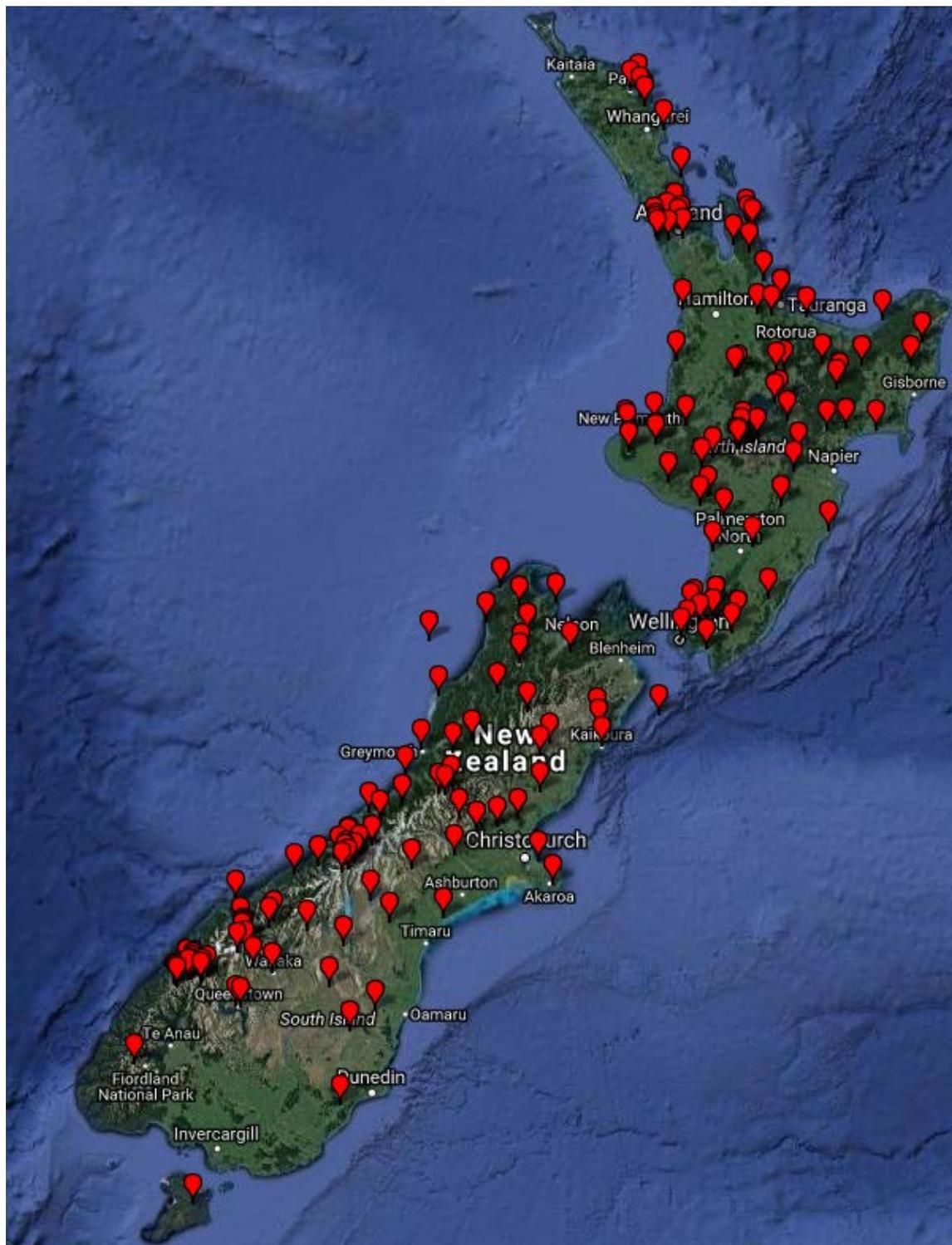


Figure 7: Land Fatalities by Location

One hundred and seventy eight cases were mapped from a possible 185 cases (figure 7). No data was provided for seven cases. Some GPS coordinates were clearly located in the sea and assumed to be incorrect. It was beyond the scope of this report to verify each case accurately, therefore all data has been presented as given.

## Demographics

### Gender

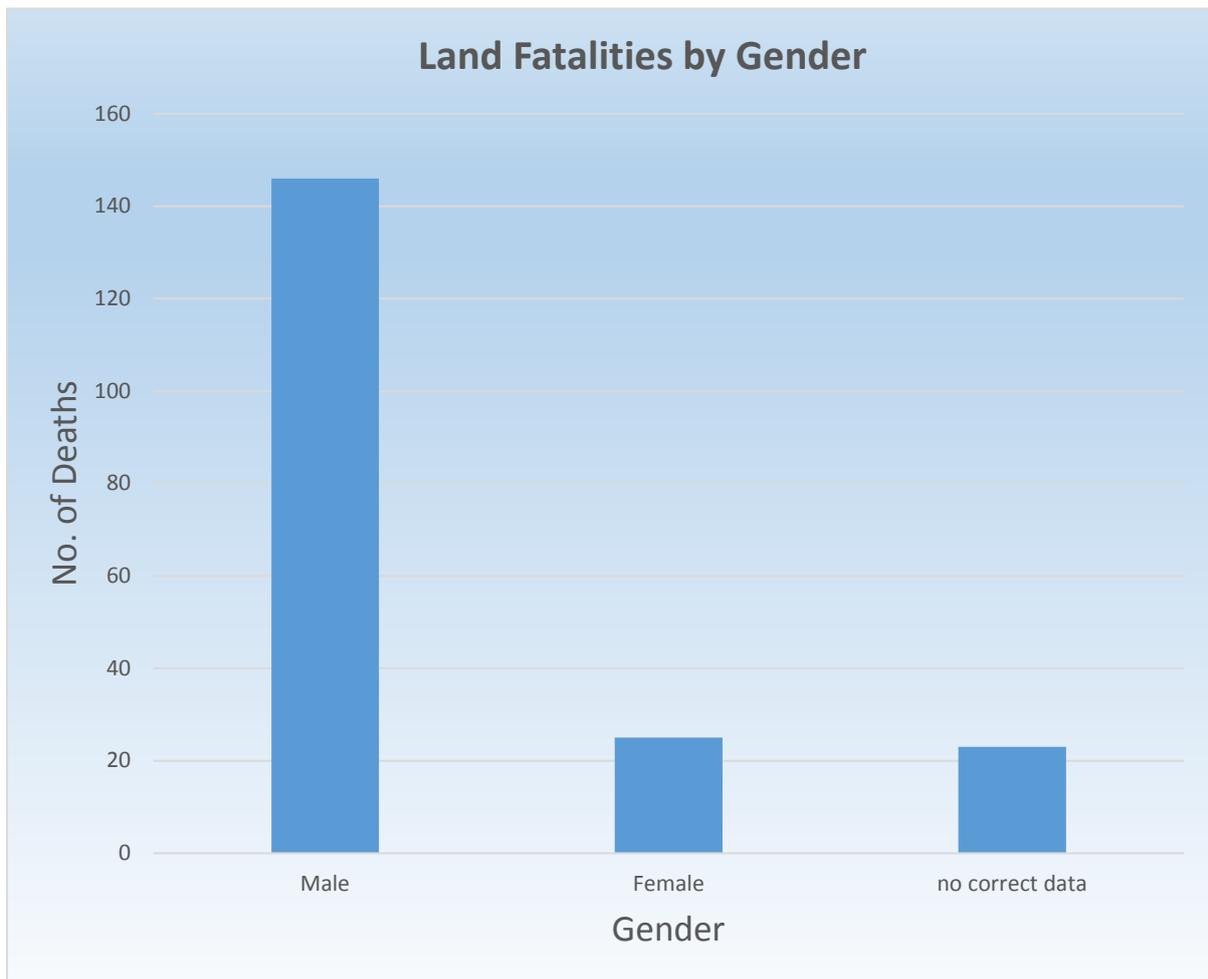


Figure 8 Land Fatalities by Gender

Males represent at least 75% of all land-based deaths although the real figure is likely to be higher as 12% of the genders were unknown (figure 8). This is in contrast to males comprising nearly 49% of the population (StatsNZ, 2013). This is consistent with a Mountain Safety report in 2016 which reports 84% of fatalities as male (Mountain Safety Council, 2016). Exploring the antecedent factors associated with the over-representation of male fatalities is beyond the scope of this report. However, it is well accepted in the literature that men exhibit more risky behaviour than women (Harris M. Glaser, D., 2006). This is consistent with the data presented.

## Age



Figure 9: Land Fatalities by Age

The data presented (figure 9) includes all land-based activities and broadly reflects the trends identified in the database as a whole. Medical emergencies accounted for a high proportion of land-based deaths (table 4), which may reflect the over representation of the 50-64 year age group.

## Ethnicity

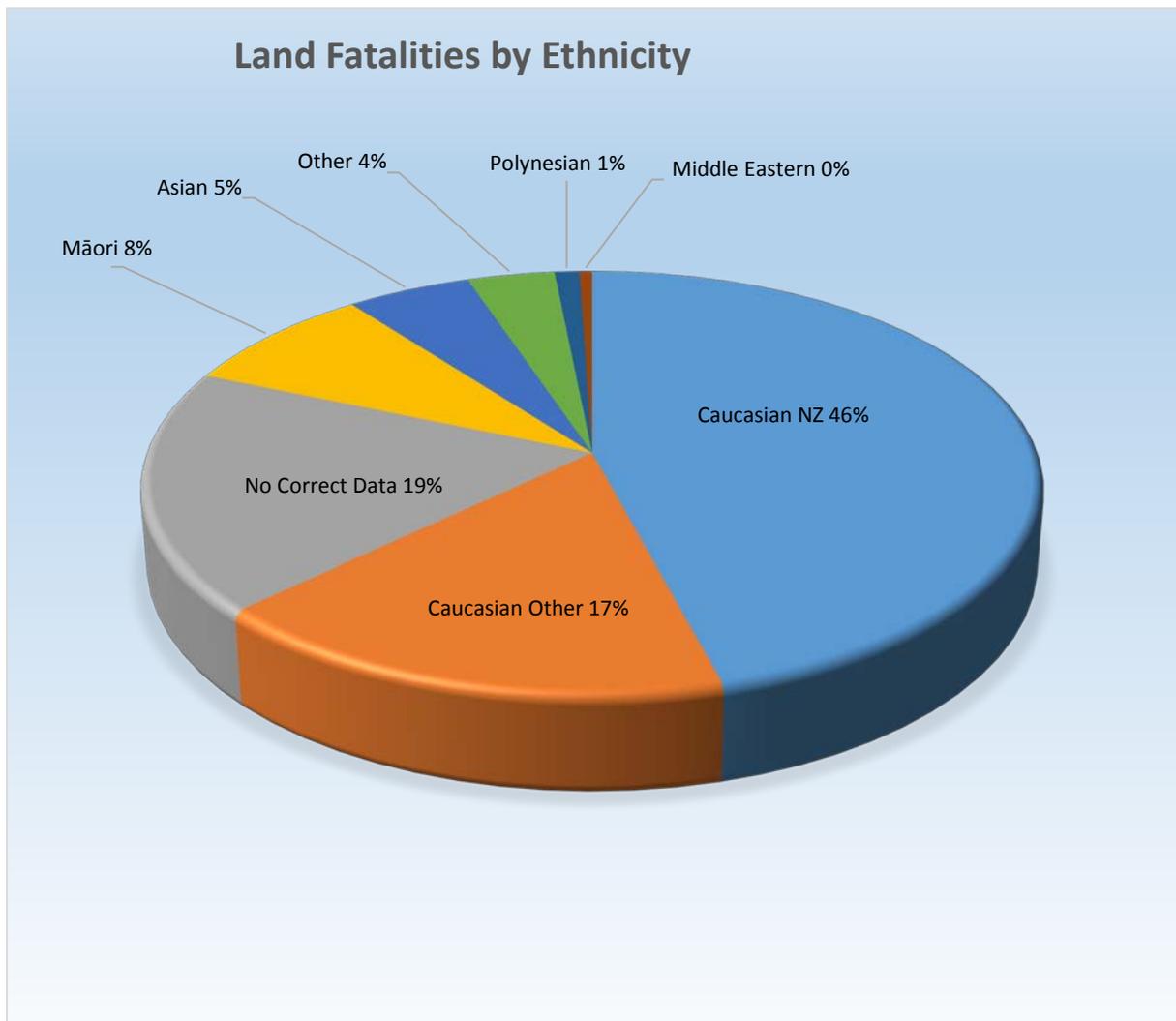


Figure 10: Land Fatalities by Ethnicity

Caucasian ethnicity is associated with 63% of land-based deaths (figure 10). The missing data limits the ability to draw conclusions relating to the possible over representation of Caucasian and under representation of Māori and Polynesian peoples.

## Types of activity

Activities were initially sorted into twelve overall categories (table 1), using the definitions as listed below.

Land Death by Activity	No. of Deaths	Percentage of Deaths
tramping	56	29%
hunting	29	15%
walking	23	12%
mountaineering	21	11%
commercial	15	8%
other	14	7%
fishing	10	5%
riding	7	4%
intoxicated	7	4%
skiing	5	2%
vehicle	5	2%
running	2	1%
TOTAL	194	

Table 1: Type of Land Activity Engaged in

### Definition of activity

#### Tramping

In many instances, the distinction between tramping and walking is problematic. Tramping was defined as a walking excursion that involved any of the following: remote or sub-alpine terrain; a multi-day outing; or terrain that was otherwise challenging enough to resemble the rugged terrain typically associated with the backcountry. The 56 tramping deaths in this study is comparable with the 45 fatalities over 7.5 years recorded in the MSC report (Mountain Safety Council, 2016, p. 28).

### *Hunting*

Where the primary activity was hunting. This was typically pig, deer or goat hunting, sometimes in remote, off-track locations.

### *Mountaineering*

This has been closely aligned with the definition used in the Mountain Safety Council report, 'There and back: An exploration of outdoor recreation incidents in New Zealand', (Mountain Safety Council, 2016). It includes technical climbing in alpine areas that typically require technical equipment (crampons, ice-axes, etc.). This generally requires specialised instruction, either from an educational course, or by accompanying an experienced mountaineer.

### *Walking*

Walking was defined as an outing lasting up to three or four hours and involving terrain consistent with urban bush walkways, farm tracks, or similar. Those cases lying on the cusp between 'walking' and 'tramping' were classified by group review.

### *Commercial*

Fatalities that occurred while engaged in commercial activities are out-of-scope, but have been included for interest at the end of this section.

### *Fishing*

This category included people who drowned while fishing, either by being swept off the rocks or beach, or falling off slippery rocks. This is an obvious cohort to target for messaging regarding buoyancy devices.

### *Riding*

This category included horse riding, mountain biking, and motor bike riding.

### *Intoxicated*

Intoxicated was used where the chemically impaired state of the victim appeared to be the most significant factor in their demise. This is not an activity as such, but was used for those engaged in otherwise benign activities that were unlikely to result in death but for the significant cognitive impairment induced by alcohol or drug use. An example is the 83 year old male who stumbled into a large river in the dark on his way to the outdoor toilet and drowned.

### *Skiing*

Five people died while skiing, four as a result of falls and one who was buried in an avalanche.

### *Vehicle*

Five people died while primarily engaged in an off-road driving activity. One suffered a fatal cardiac arrest while four-wheel driving. Three died while river crossing, two in the same incident. The last died when he lost control of his vehicle and crashed.

### *Running*

Running accounted for only two of the victims and involved those out for a run.

## Other

The 'other' category includes an assortment of sometimes random circumstances that were otherwise difficult to order, or for those where the cause of death was not clear. For example, one victim became surrounded by flood water while sleeping in his car. He tried to wade to safety, but was swept away and drowned. Another was washed into the sea while sight-seeing at a blow hole. A number were found dead (in the sea or on land) having last been seen on land in the midst of normal daily activities. It is assumed that they went walking and experienced a sudden medical event, or were swept or fell into the water and subsequently drowned.

## Commercial (out-of-scope)

Fifteen deaths occurred while the victims were engaged in some form of commercial activity. Table two provides a breakdown of the types of commercial activity engaged in when the victims died. Table three provides a breakdown by cause.

Commercial Deaths by Activity	No. of Deaths	Percentage of Deaths
farming	8	53%
adventure	3	20%
forestry	2	13%
military	1	7%
water sampling	1	7%
<b>TOTAL</b>	<b>15</b>	

Table 2: Breakdown of Commercial Fatalities by Type of Activity

Commercial Deaths by Cause	No. of Deaths	Percentage of Deaths
road traffic crash	5	33%
drowned	4	26%
trauma	2	13%
fall	1	7%
fire	1	7%
medical	1	7%
unknown	1	7%
<b>TOTAL</b>	<b>15</b>	

Table 3: Breakdown of Commercial Fatalities by Cause

Farming accounted for the majority of the commercial deaths. Five of these were as a result of vehicle accidents (two 4WD, two quad bike and one tractor); two of the remaining three were as a result of fire and medical. The last was categorised as unknown. Three people were swept off Paritutu rock in New Plymouth and drowned in a high publicity case while under the direction of a commercial guide in 2012; they were categorised as 'adventure'. Two of the deaths were secondary to traumatic injuries received in forestry accidents. The remaining fatality occurred during an Australian military mountaineering training exercise; the cause of death was a fall.

## Mechanism of injury (cause)

This level of categorisation relates to the mechanism that ultimately resulted in death. The ten mechanisms in this category in descending order of frequency can be found in Table 4. This list includes those killed in commercial incidents.

Mechanism of Injury by Cause	No. of Deaths	Percentage of Deaths
fall	60	30%
drowning	51	26%
medical	46	24%
unknown	18	9%
Road traffic crash	8	4%
shot	4	2%
hypothermia	3	2%
trauma	2	1%
fire	1	1%
avalanche	1	1%
<b>TOTAL</b>	<b>194</b>	

Table 4: Mechanism of Injury Resulting in Death: Includes Commercial Deaths

### Falls

Sixty of 194 fatalities in the Land category were due to falls, making it the biggest cause of death (table 4). This included many backcountry falls, where trampers, hunters and mountaineers fell to their deaths, and also falls from cliffs in urban areas.

### Drowning

Fifty one deaths occurred due to drowning. Many of the drowning victims probably wouldn't have considered themselves to be engaged in a high-risk activity (walking along the beach, fishing from the rocks, clambering around the rocks). Consequently, few would have considered wearing a buoyancy device. The drowning deaths were further broken down into sub-categories (Table 5).

Specifics of Drowning Deaths	No. of Deaths	Percentage of all Land-based Deaths
crossing river	15	37%
swept off rocks	11	27%
fell into water	8	19%
swept out to sea	7	17%
<b>TOTAL</b>	<b>41</b>	

Table 5: Breakdown of Drowning Fatalities

### Medical

Medical events were the third highest cause and accounted for 46 deaths. It is impossible to determine with certainty the exact medical cause from the database description, but the experienced paramedics in the study team were able to make inferences from the information provided. The majority were typically sudden cardiac arrests: either primary arrests, where a sudden arrhythmia causes the heart to abruptly stop pumping, or a myocardial infarction resulting from a blocked coronary artery. Other catastrophic medical events that could cause death in this setting include: a massive stroke (secondary to a blocked or ruptured cerebral artery), or a ruptured aortic aneurysm (either thoracic or abdominal). From the descriptions it is clear that few of these events were survivable unless they had occurred within minutes of a Tertiary Hospital.

Messaging for this category is difficult. Many of these events might have occurred whether the person went into the wilderness or not. Any vigorous exertion after a period of inactivity could result in a sudden cardiac arrest.

### Unknown

This category captured those whose death was from an uncertain cause, either because the body was not found until in a state of decay (or similar) or due to database limitations. Determining actual cause from coronial reports was beyond the scope of this study.

### Road traffic crash (RTC)

This is a term used by the New Zealand emergency services to describe a vehicle crash. It includes all types of motorised vehicles. The term does not technically describe some of the events from the database because they did not occur on a road. However, as it represents the national convention, it has been used in this report. A total of eight people died while driving some form of motorised vehicle.

## Shot

Four victims were shot while engaged in hunting. One died as a result of an accidental discharge, while the remaining three were mistaken for game. The latter is a common cause of death while hunting (Wilson & Bridges, 2015).

## Hypothermia

This category is for the few fatalities (three) who died of hypothermia.

## Trauma

Trauma includes those that died from traumatic injuries, but who didn't fit into any other category. Only two deaths fitted this description, both resulting from forestry accidents.

## Fire and avalanche

One death was caused by a scrub-clearing fire during a commercial farming operation. One death occurred when the deceased was buried in an avalanche during a heli-skiing trip.

# Discussion

## Falls

“Lost footing. Couldn't self-arrest. Fell to death.” In North America this sequence results in death so frequently that it has become an official phrase (Gonzales, 2003, p. 143).

If this mechanism occurs while *descending* is more likely to result in fatal consequences than when ascending. This fact is not universally known by those who venture into steep or unstable terrain and is therefore an obvious message to target, especially given that falls were the leading cause of death by a significant margin.

When planting a foot during a descent, there is less opportunity to test the traction of the placement before the full weight of the body is committed to the step. When ascending, the weight remains on the downhill leg until the foot placement has been made, and even if a loss of traction occurs it is more recoverable because the foot that slips has little weight behind it. Also, if the downhill foot slips during a descent, the direction of travel is downhill, meaning that there is more momentum to overcome in terms of recovery. These factors combine to produce a more rapid initial mechanism of fall, as opposed to the slower (and therefore more recoverable) mechanism which occurs when ascending (Gonzales, 2003). Despite the frequency such accidents, experienced climbers and trampers are often unaware such hazards.

The highest proportion (60 of 194, or 31%) of the Land-based deaths were secondary to falls, and it is reasonable to assume that many of the accidents occurred due of the mechanism described above. New Zealand's sub-alpine zone, typically occurring between 1200 and 1500 metres, consists of challenging terrain that can be as dangerous as the high mountains, while not appearing to be so (Mulheron, 2015). Sub-alpine terrain lends itself to slips and falls, which can occur anywhere, but which may be more likely to have fatal consequences in the sub-alpine zone. This is partly because it is accessible to those who are less experienced, and partly because of the rugged and uneven

terrain. Simply making trampers aware that falling is the leading cause of death in the backcountry may help to reduce accidents.

### Drowning

An obvious messaging point here would be to urge people to use a floatation device such as a life jacket if they are engaging in a shore-based activity which places them adjacent the water. Examples of such activities include clambering around rocks, fishing from the rocks, or surf-casting in the wash zone on a shelving beach.

Beyond that, it is very difficult to promote messaging as most of those who drowned did not set out to enter the water on purpose. Additionally, steeply shelving beaches on rough days are extremely dangerous, yet this is not intuitively obvious. *Any* beach, which might be very safe on any given day, may be unsafe on another day. Again, this adds to the difficulty in educating people and providing simple safety messaging. Any message that is too restricting, for example, “Stay away from the water at all times” is likely to result in the advice being ignored. But the process of learning how to be safe in a potentially dangerous environments is not straight forward, especially if this process is through trial-and-error, as opposed to learning alongside an expert.

McCammon (2001, p. 4) describes two types of backcountry learning environments: those where feedback from decisions is *progressive*, allowing novices to discover their own set of rules of thumb (heuristics). And those where the feedback is *catastrophic*. In the latter setting the decision to cross a marginal river, for example, is an ‘all-or-nothing’ venture; either the party are capable of the crossing or they are not. He emphasises that “...catastrophic environments are poor places to learn through trial-and-error” (p. 8).

### River crossings

A rise in river level that appears insignificant to an inexperienced eye can result in two changes that drastically decrease the chances of a successful crossing. They are: an increase in water force directly pushing on the person crossing; and decreased foot traction on the river bottom due to a greater proportion of body weight being submerged and therefore more buoyant. The increased buoyancy leads to less downward force on the river bottom, resulting in even a small increase in water force to become significant (Federated Mountain Clubs, 2012, p. 16).

Other factors that come into play are: the runout (recovery area should one get swept off one’s feet); the width; the depth; the water temperature; the amount of clothing (and therefore weight and drag); and the weight of any pack being carried. At times, a heavy pack may provide extra foot traction on the river bottom, but will simultaneously making the person less agile. Additionally, all but one member of a party might be capable of crossing, which may lead to difficult decisions when some or all members have crossed safely. This situation may add to the pressure experienced by the weaker party members to give the crossing a try.

It is unrealistic to expect that parties will never attempt a crossing if the slightest doubt exists. During the study period it is likely that many thousands of crossings were undertaken successfully and safely. Beyond a certain point, messaging does not help with activities such as river crossings because it is necessary to develop intuitive expertise; this cannot be gained without exposure and therefore risk (McCammon, 2001).

## Hypothermia

An interview with tramping historian Shaun Barnett supported some of the trends found within the NZSAR data (Shaun Barnett, personal communication). He confirmed that hypothermia had been a leading cause of death in the backcountry prior to the 1960s, but has become proportionally less common. A graph modified from data published in the monthly newsletter of the Tararua Tramping Club demonstrates this trend (Tararua Tramping Club, 1991, p. 8). The number of hypothermia deaths peaks in the 1950s and then steadily decreases (blue bars), while the number of deaths from other causes (predominantly drowning) steadily increases (green bars) (see Figure 11, modified graph).

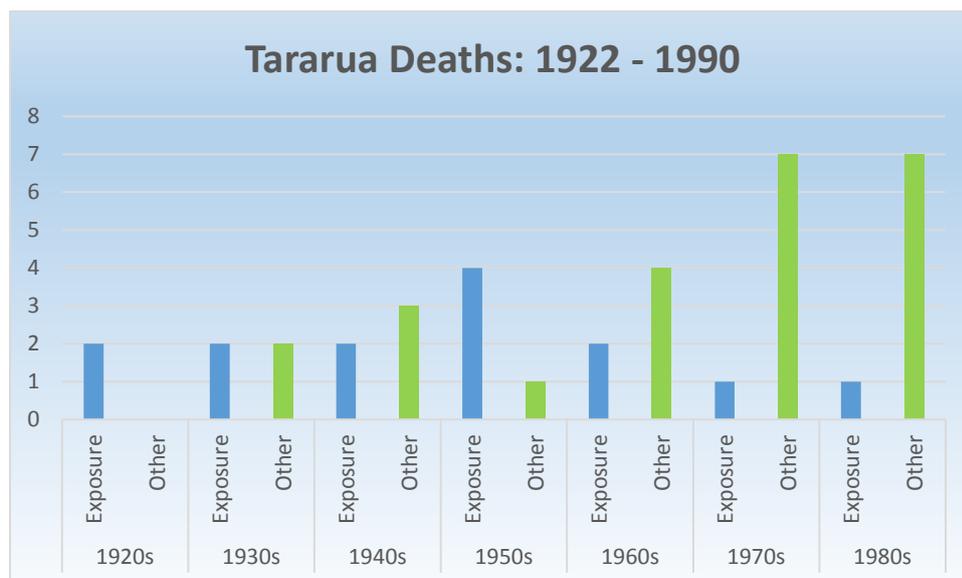


Figure 11: Deaths in the Tararua Ranges, 1922 – 1990.

### Reference

Tararua Tramping Club. (1991, October). Tararua Deaths - 1922 - 1990. *The Tararua Tramp*, 8,9.

Walrond documents the historical high incidence of hypothermia in his book 'Survive! Remarkable tales from the New Zealand outdoors' (Walrond, 2008). One incident that clearly portrays this historical trend is that of three teenagers who became lost while walking the Wangapeka Track in Kahurangi National Park in 1968. Over the course of two or three days, during which they were exposed to severe weather including snow, two of the boys died of hypothermia. The third managed to find a hut and was eventually rescued safely. The alarm wasn't raised until the party failed to appear on the day they were due out; by this time the two victims were already dead.

According to Barnett, the reasons for the decrease are multifactorial, but include: improvements in outdoor clothing; decreased rescue times; increased performance abilities of rescue helicopters; improvements in weather forecasting; and the advent of specialised rescue teams which are able to operate on narrower safety margins. A brief exploration of each of these elements is enlightening.

### Improvements in outdoor clothing

Oilskin rainwear became available in the 1930s and was a significant step forward in clothing technology. Prior to that, those venturing into the outdoors would be clad in heavy woollen suits similar to the work or streetwear of the time. Once wet, these did little to prevent heat loss,

particularly if wind-chill was a factor. In contrast, modern breathable waterproof parkas covering lightweight thermal undergarments retain less moisture and prevent the wind from cutting through the clothing. The result is dramatically decreased heat loss from wet clothing and wind-chill.

#### Decreased rescue times

Barnett breaks this dimension down into three key elements: decreased activation time, improved ability to locate victims, and faster extrication to medical care.

#### Decreased activation times

High-tech communication devices allow activation of rescue much earlier than in the pre-cellular era. While blanket cellular coverage does not yet exist across the New Zealand wilderness, cell phones nonetheless provide vastly improved communication with rescuers than previously. Additionally, the development of lightweight, affordable personal locator beacons (PLBs) means that the alarm can be raised in areas that lack cellular coverage.

#### Improved ability to locate victims

Hand held global positioning system (GPS) devices carried by backcountry travellers enable exact coordinates to be sent to rescuers, even when those in trouble are not sure of their own whereabouts. The result is a dramatically decreased time to rescue as the helicopter can fly straight to the location, rather than having to search a large, bush-covered area. For the same reason PLBs have also made a vast difference in this regard.

#### Faster extrication to medical care

Barnett describes how in the pre-helicopter rescue era, multi-day stretcher carries of victims to the nearest road was the norm. During freezing weather, a relatively minor injury by today's standards may have resulted in life-threatening hypothermia.

The 'Trauma Triad of Death' is a term coined to describe the lethal combination of hypothermia, acidosis and coagulopathy which can lead to a vicious downward spiral for trauma patients with significant bleeding (Mitra, Tullio, Cameron, & Fitzgerald, 2012). In the last 20 years substantially more of these patients have been surviving, largely due to early access to advanced medical care at tertiary trauma hospitals (Mitra et al., 2012). An example would be the case of a woman who was helicoptered from the Orongorongo Track with a broken leg in 2003 (Kerr, 2003). It is possible to lose between 1 and 2 litres of blood from a femur fracture, meaning that this patient was at risk of significant haemorrhage. The accident occurred in mid-winter (20 July). The flight time to Wellington Public Hospital is approximately 15 minutes. A similar rescue in the 1950s would have exposed a patient to the elements for many hours before receiving advanced medical care. This would greatly increase the risk of hypothermia, contribute to the trauma triad, and increase the risk of death.

#### Technological improvements for helicopters

Barnett cites improvements in helicopter technology as a factor in the speed of rescue. Five-bladed machines are much more stable than the older two-bladed versions, allowing them to carry heavier loads and cope with stronger winds. They can hover close to terrain in poor weather, making it possible to rapidly evacuate a patient. Advances in winch and strop technology mean that patients

are able to be extricated on a stretcher through dense bush canopies, and plucked from cliff faces or the sea. Improvements in night flying ability enables rescues in the dark which would have been impossible in the past. More accurate weather forecasting means a rescue can be initiated during a narrow weather window of as little as 30 to 90 minutes. Thermal imaging goggles used by helicopter crews allow victims to be spotted through the bush canopy.

Finally, the evolution of specialist rescue services has meant that teams are able to safely operate on narrower margins.

Barnett believes that the combination of these factors are gradually changing 'Search and Rescue' to 'Alert and Rescue'; the requirement for the extensive searches of the past is diminishing. The database reports numerous large searches, but few where the subjects were found alive.

Consider the 1968 Wangapeka tragedy mentioned earlier. The same scenario playing out today for a party carrying a PLB would likely mean a rescue being initiated immediately, a precise location for rescuers to target, and rapid extrication by helicopter.

### Personal locator beacons (PLBs)

Of the 183 SAR activations in the Land category, 21 (11%) were triggered by PLBs. This is a significant proportion given that many of the rescues may have occurred within cell phone coverage areas, meaning that PLBs could have been used far more frequently. A useful analysis would be to calculate the proportion of activations that were triggered by PLBs in areas where there was no cell phone coverage.

Considering the deaths in the Land category it is clear that few of them would have been prevented if the victims had carried a PLB. The three main causes of death were: falls, drowning and medical. These accounted for approximately 80% of all the deaths in this category. From the descriptions in the database, many of the falls resulted in catastrophic injuries which would have prevented the victim from activating a PLB. One case report of a solo tramper (not from the database) clearly illustrates this type of situation:

"A post-mortem revealed major injuries to the tramper's head, chest and limbs, suggesting that he would have been incapacitated immediately and died soon afterwards."

(Plimmer, 2014).

Similarly those in the Land category who drowned would have been in no position to activate a PLB and would not have been saved even if they had done so. The same is true of the medical events, which from the descriptions in the database were generally massive and catastrophic.

The most significant situation where PLB use saves lives appears to be for those who are incapacitated to the point where they are unable to rescue themselves, but who do not have critical injuries which will inevitably result in death. The case of the three teenagers lost in the Wangapeka in 1968 cited earlier is an example. The other situation is where the victims are not injured, but are unable to rescue themselves due to circumstances.

## Recommendations

- Consider buoyancy devices if you are planning to engage in an activity near the sea or on a riverbank.
- Education around fall prevention. Further research into causes of falls and the specific terrain in which most of them occur.
- Database: Improve data fields to include 'forced response' formats to ensure accurate data collection.

## Water-based activities

This section relates to deaths that occurred while intentionally engaged in water-based activities. The vast majority of fatalities in this category occurred in the water and by far the most common cause of death was drowning.

Water Fatalities by New Zealand Location

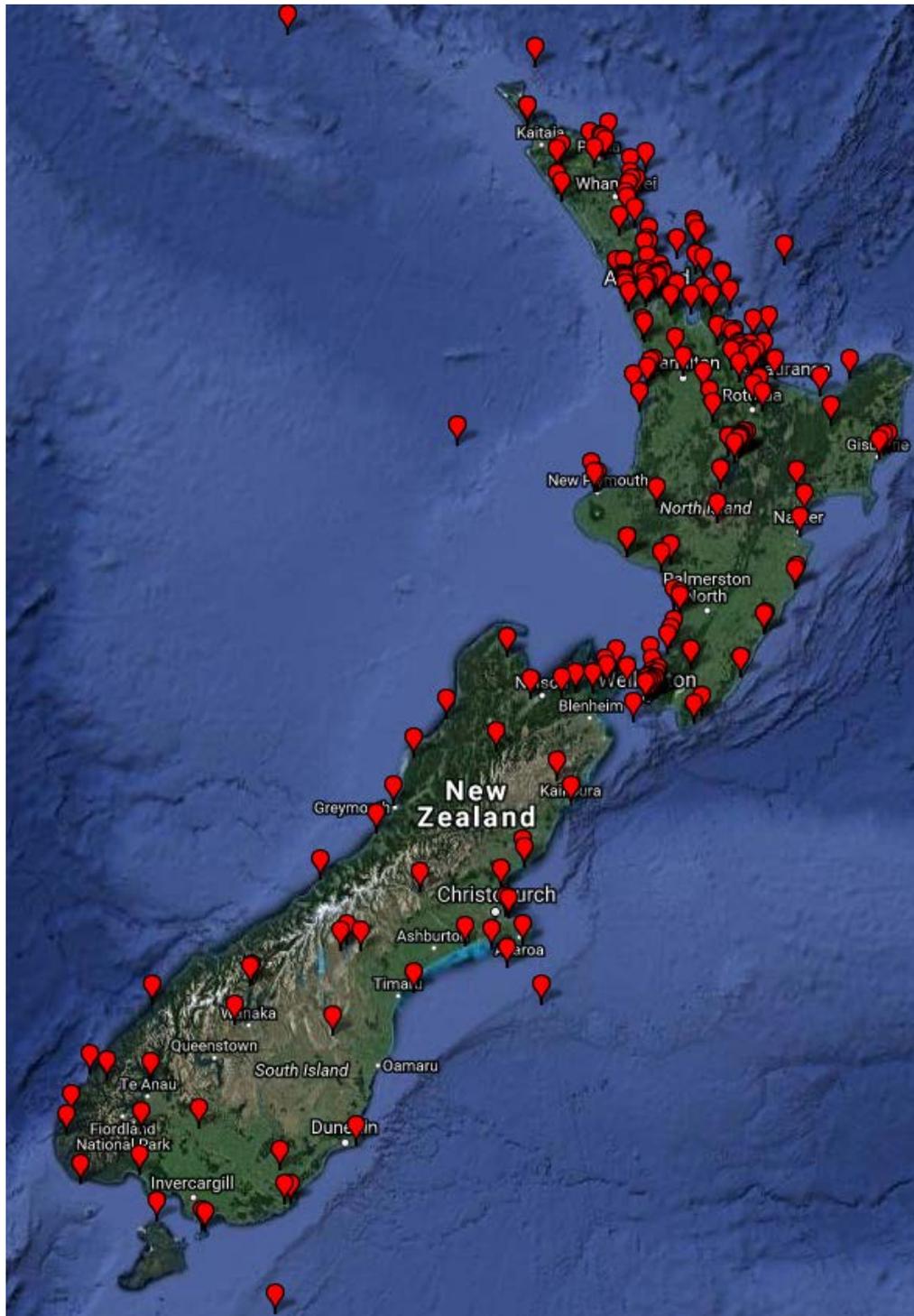


Figure 12: Water Fatalities by Location

The GPS coordinates used are from data supplied and unable to be verified further. Two hundred and twenty eight cases were mapped from a possible 232 cases. No data was provided for four cases.

Water fatalities were concentrated around coastal and lake regions as well as high frequency areas for water recreation, including Auckland, Wellington, Taupō and Bay of Plenty (figure 12). Unlike the Land category, where the causes of death were both clearly distinct and useful for messaging, the causes of death in the water category were far less clear. For example, there were numerous instances where someone fell overboard, resulting in either drowning or hypothermia. In the latter stages of hypothermia victims begin to lose consciousness and are unable to keep themselves afloat; drowning follows rapidly. However, identifying the exact mechanism of death among fatalities in this category would not change the messaging relating to water safety.

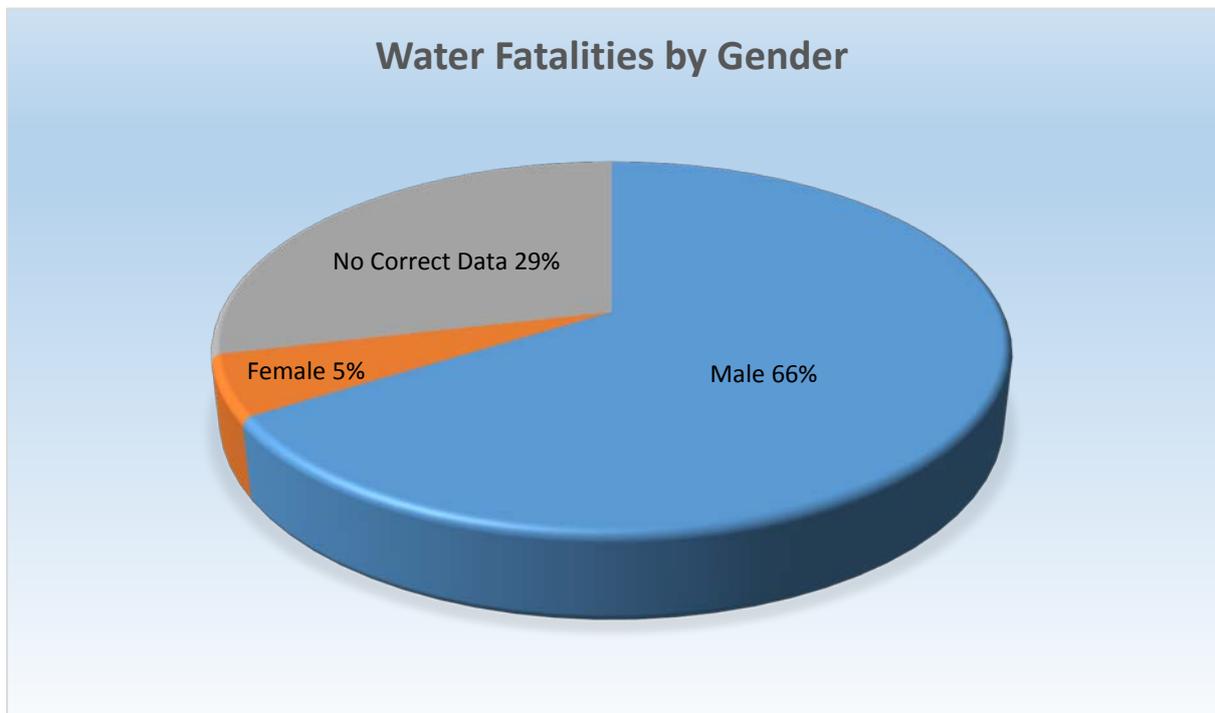
Similarly, from the narratives it seemed likely that a number of people drowned due to a medical event while they were swimming. The same medical event occurring on land, a mild heart attack for example, may have been survivable. But in a water environment, many events survivable on land result in an autopsy finding of drowning, even though the mild heart attack was the precipitating factor. Given these limitations, table 6 outlines the causes of death.

Deaths by cause	Number of deaths	Percentage of Deaths
drowned	264	82%
unknown	37	12%
medical	12	4%
hypothermia	4	1%
trauma	3	1%
<b>TOTAL</b>	<b>320</b>	

Table 6: Fatality Breakdown by Cause

## Demographics

### Gender



*Figure 13: Water Fatalities by Gender*

Sixty-six percent of water-based fatalities were male (figure 13). This is consistent with male attitudes as noted by Kalafatelis (2014) who suggests that females are more likely to place importance on checking marine weather forecasts, avoiding alcohol and have a higher regard for lifejacket use. Alcohol and lifejacket use have been noted as key contributing factors in this report.

## Ethnicity

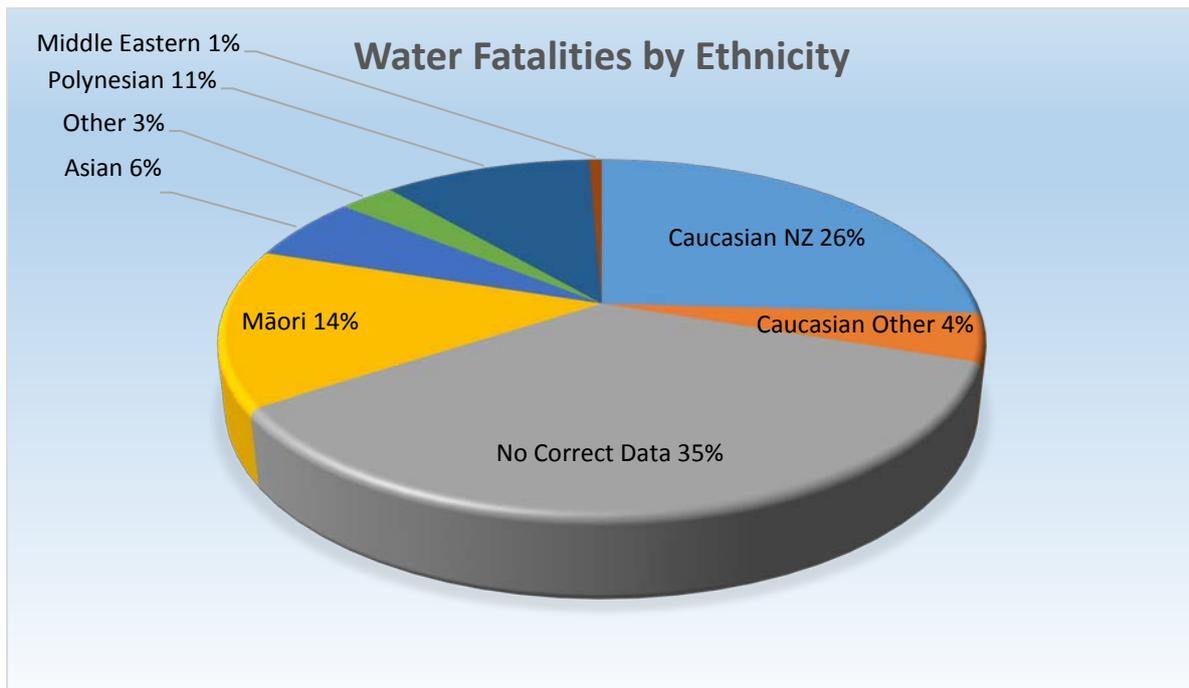


Figure 14: Water Fatalities by Ethnicity

It is difficult to draw meaningful conclusion regarding ethnicity, as 36% of the data was either missing or inaccurate (figure 14). Polynesian and Māori are over-represented as they currently account for 24% of the deaths compared with 22% of the population (StatsNZ, 2017). This over-representation is also likely to be an under-estimate. Working on the assumption that the missing ethnicity data are distributed similarly, Polynesian and Māori deaths would represent more than 30% of all water-based fatalities.

## Age

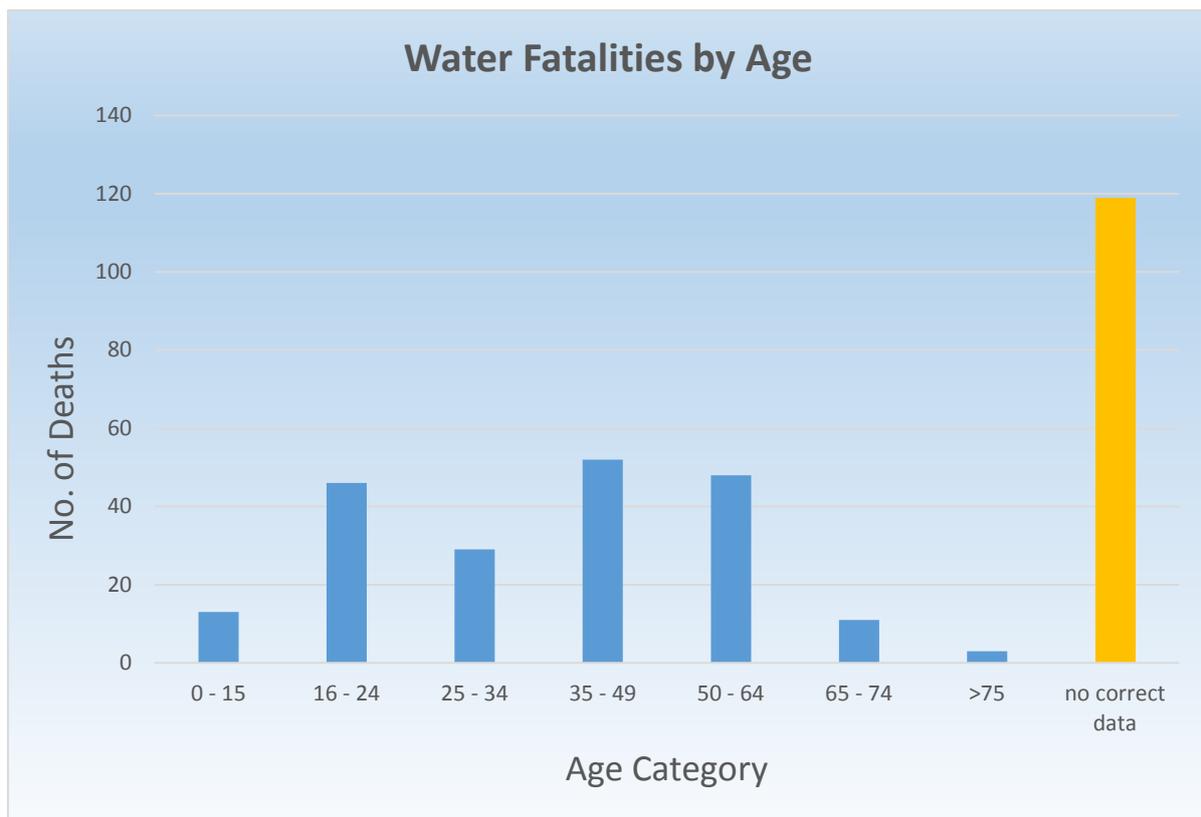


Figure 15: Water Fatalities by Age

It is difficult to draw accurate conclusions as 37% of the deaths had missing data and the water activities represents a wide variety of activities (figure 15). This ranged from deep sea commercial fishing (although these are out-of-scope) to small dingy fishing, swimming and net setting.

## Types of activity

Figure 16 shows the fatality breakdown by the activity engaged in by those involved.

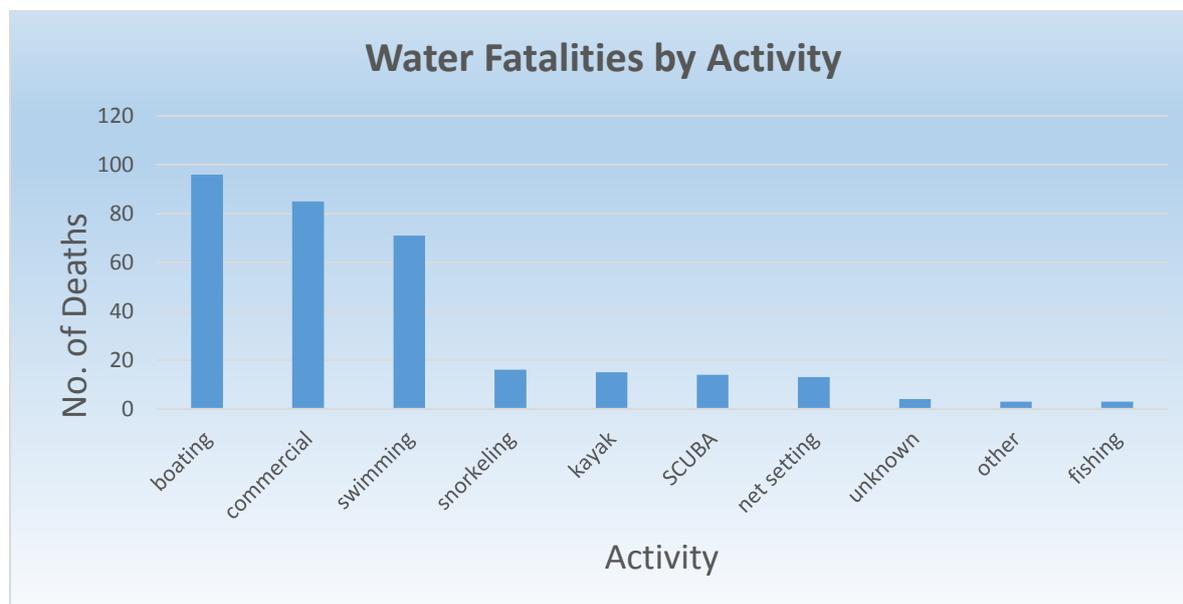


Figure 16: Water Fatalities by Activity

### Boating

This category includes vessels of all sizes that were engaged in a recreational activity, from large fishing vessels to the smallest dingy. Jet skis were also in this category. Kayak deaths were numerous enough to warrant a separate category. Boating excludes those ventures where a professional skipper was paid to lead the expedition.

Ninety five of those who perished from the total of 320 were boating at the time. This accounted for 30% of the total number of deaths.

### Swimming

The third most frequent activity was swimming, with 71 people drowned (22%). The majority of these set out with the intention of swimming for recreation, mostly from beaches.

### Snorkelling

Snorkelling includes free-diving (non-SCUBA), spear-fishing and casual snorkelling. The well-known term snorkelling was used in preference to the newer terms. Any activity that involved breath-holding, and use of a mask and flippers (with or without a snorkel) would be included in this category. Sixteen people died (5%) while engaged in a snorkelling activity.

### Kayak

Kayak-style boats, which are distinctive and numerous, were included in this category.

Kayaking accounted for fifteen fatalities (5%), making it the fourth most common activity leading to death (once commercial is excluded).

## SCUBA

An acronym for 'self-contained underwater breathing apparatus', SCUBA was the term chosen for those engaged in underwater diving activities that involved compressed air tanks (or other gas mixtures).

A total of fourteen people (4%) perished while engaged in SCUBA activities. Of note was the difficulty determining the exact cause of death. Typically if occurred via one of three mechanisms, or a combination thereof: a diving emergency; drowning; or a medical event. The physiological strain caused by pressure changes while engaged in SCUBA diving makes participants particularly susceptible to medical events. Using the example of a mild heart attack again, if this happens while the participant is 30 metres underwater it is likely to result in a dire outcome, despite being very survivable on land. When a diver surfaces in difficulty or unconscious, it is difficult to distinguish between a drowning precipitated by a medical event, a drowning precipitated by a diving emergency, and a diving emergency on its own.

## Net setting

This was a category that emerged from the data; thirteen people (4%) died while setting, checking or retrieving nets in tidal waters or river mouths. It represents an obvious target for messaging as participants know in advance they will be entering bodies of water that often contain strong currents.

## Unknown

This was reserved for those fatalities where the cause was not clear, or where it was obviously one of two causes (drowning or medical, for example).

Four deaths (1%) fell into this category. Two bodies were recovered from the water after members of the public spotted them floating. Two more people were heard calling for help, one in the sea and one in a river. Both subsequently perished due to a probable medical event, drug or alcohol-related impairment, drowning, or a combination thereof.

## Fishing

This category was for those who were fishing, but were not involved in one of the other categories. There were three deaths (1%), all as a result of fly-fishing or surf-casting; two of the three were near a river mouth.

## Other

This category was for those whose deaths occurred due to some event which was too obscure to produce its own category, or a combination of categories. Three fatalities (1%) were coded into this group. They were: a knee-boarder who failed to surface after a crash while being towed behind a boat; a man who set out on a jet-ski to go fishing; and a man who failed to return from a solo canyoning trip.

### Commercial (out-of-scope)

Eighty five of the deaths (27%) occurred on a commercial enterprise. Examples include a crew member who fell overboard from a cargo ship and was lost at sea. It also includes those who had engaged a professional skipper (or professional guide) to lead the activity. For example, the 'Easy Rider' tragedy, where a large fishing vessel with a crew of three was transporting six passengers to a small island in Foveaux Strait for mutton-birding.

Four multiple-death incidents accounted for 48 of the 85 fatalities (56%). They were: a Korean fishing trawler that sank in Antarctic waters, killing 22 crew members; the aforementioned 'Easy Rider' capsized, in which eight people died; the Kaipara bar capsized, which claimed eight lives; and a storm in the Pacific in which ten Samoan fishermen were lost.

## Activity breakdown by sub-category

Water-based activities with the most fatalities were broken down further by sub-category. For example, boating (96 deaths) was a broad category and was therefore split by cause of accident (Table 7).

Boating fatalities by cause of accident	Number of Deaths	Percentage of Boating Deaths
capsized	29	30%
man overboard	19	20%
unknown	19	20%
boat sunk	16	17%
forced swim	5	5%
medical	5	5%
collision	2	2%
trauma	1	1%
<b>TOTAL</b>	<b>96</b>	

Table 7: Boating Fatalities Sub-categorised by Cause of Accident

### Capsized

A capsized is distinct from a boat that sinks: in one instance the boat remains upright, but sinks, leaving those on board in the water; while in the other the boat flips upside down, allowing crew members to remain afloat for a considerable period of time by clinging to the hull.

### Man overboard

This mechanism accounted for nineteen deaths in the boating category. In a number of instances it was known that a crew member had been lost overboard and the vessel turned to commence a search, but the deceased was not found.

### Boat sunk

This type of accident accounted for 16 fatalities. The cause of the boat sinking was often unclear in the narrative, therefore no significant trends were noted and no recommendations offered.

### Forced swim

This category emerged from the data. It describes a situation where someone has been forced into swimming due to circumstances, as distinct from a planned recreational swim. An example from 2012 is the 62 year-old male who rowed to a moored vessel with a friend with the intention of working on it. The dingy came adrift, stranding the two men on the larger boat. The deceased entered the water in an attempt to retrieve the dingy, but was overcome by the current. Five people perished in this manner, including two where alcohol appeared to be a significant factor.

## Medical

Five people died due to an unrelated medical event which happened to occur while they were on a boat.

## Collision

Two people died as a result of collisions. One collided with a rock in a river, flipping the boat. The database provided no narrative for the other, but had 'collision with structure' selected in the 'other' column.

## Trauma

There was a single incident of trauma, that of a person struck by the boom of a yacht who died shortly afterward. A second person was knocked overboard in the same incident.

## Unknown

This sub-category describes those accidents where a boat was not found, or was found but with no sign of the crew, or wreckage is discovered, but the cause of the accident was not apparent from the database. In some instances the bodies were located sometime later. Nineteen of those who perished were in this category. One incident accounted for one third of the total dead. In 2013 the schooner 'Nina' was reported overdue from a trans-Tasman voyage with seven crew aboard. The vessel was never found.

## Boating by environment

Boating was also sub-categorised into the type of water environment (Table 8). The four categories were:

- Coastal – a range of less than five km from the coast of mainland New Zealand was selected
- Blue water – any boating activity occurring more than five kilometres from the coast of mainland New Zealand
- River – any fatality that occurred in a river
- Lake – any fatality that occurred in a lake

Boating by Environment	Number of Deaths	Percentage of Deaths
coastal	59	62%
blue water	27	28%
river	6	6%
lake	4	4%
<b>TOTAL</b>	<b>96</b>	

Table 8: Boating Fatalities by Environment

### Coastal

The majority of boating fatalities (62%) occurred in coastal waters. This is not surprising given that most recreational boating takes place in this zone.

### Blue water

Twenty nine deaths (28%) occurred in blue water incidents. These were mostly a combination of ocean-going yachts typically hundreds of kilometres offshore, and a mixture of other vessels (usually engaged in fishing) much closer to shore, but more than five kilometres off the coast of mainland NZ.

### River

Six people (6%) died in rivers while boating.

### Lake

Lake accidents accounted for four deaths (4%).

## Other Sub-categories

### Blue water sub-categorisation

The twenty seven blue water deaths were further broken down into regions (Table 9). The Pacific Ocean was the location for thirteen deaths; the Southern Ocean saw three; while none occurred in the Tasma Sea. Coastal NZ waters (beyond 5 km offshore) claimed the final eleven lives.

Blue Water by Region	Number of Deaths	Percentage of Deaths
Pacific Ocean	13	48%
NZ	11	41%
Southern Ocean	3	11%
Tasman Sea	0	
<b>TOTAL</b>	<b>27</b>	

Table 9: Blue Water Deaths by Region

### Vessel size

The database contains a dropdown field to indicate the various vessel sizes involved in accidents; these are broken down in Table 10. Database completion limitations have resulted in the majority of results being 'NULL' (64%); in other words, this field was filled out only 36% of the time.

Vessel size (metres)	Number of Vessels	Percentage of Vessels
0 - 3	23	10%
3 - 5	29	13%
5 - 8	15	6%
8 - 10	2	1%
10+	15	6%
NULL	149	64%
<b>TOTAL</b>	<b>233</b>	

Table 10: Boating Incident Vessel Size

## Swimming deaths by environment

Swimming deaths were also sub-categorised by the same four water environments (Table 11).

Swimming by Environment	Number of Deaths	Percentage of Deaths
coastal	36	51%
river	26	37%
lake	9	12%
blue water	0	
<b>TOTAL</b>	<b>71</b>	

Table 11: Swimming Fatalities by Environment

The majority of deaths (51%) while engaged in a recreational swimming activity occurred in coastal waters. This was typically from a beach, and a significant number of these people were swept away from shore by waves, a rip or a current.

Rivers accounted for twenty six deaths, while nine people perished in lakes. No blue water swimming deaths were recorded; few people would attempt a recreational swim further than 5 km from New Zealand's coast.

## Commercial fatalities breakdown

The commercial water-based deaths were considered out-of-scope for the study. However it is useful to provide a breakdown of these deaths by activity (Table 12) and environment (Table 13). The commercial deaths by environment are further broken down by region (Table 14).

Commercial deaths by activity	Number of deaths	Percentage of Deaths
boating	81	95%
SCUBA	4	5%
<b>TOTAL</b>	<b>85</b>	

Table 12: Commercial Fatalities by Activity

The vast majority of deaths (81 of 85, or 95%) in the commercial category occurred while boating. SCUBA activities accounted for the remaining four (Table 12).

Commercial deaths by environment	Number of Deaths	Percentage of Deaths
blue water	62	73%
coastal	20	24%
lake	3	3%
river	0	
<b>TOTAL</b>	<b>85</b>	

Table 13: Commercial Fatalities by Environment

Blue water incidents resulted in 62 of the 85 commercial deaths (73%) (table 13). A further twenty occurred in coastal waters (24%) while the remaining three were in lakes (4%).

Commercial Blue Water Deaths	Number of Deaths	Percentage of Deaths
Southern Ocean	32	52%
NZ	15	23%
Pacific Ocean	14	23%
Tasman Sea	1	2%
<b>TOTAL</b>	<b>62</b>	

Table 14: Commercial Blue Water Deaths by Region.

The regions in which the blue water commercial deaths occurred (table 14) were: 32 in the Southern Ocean (including 22 in the Korean fishing trawler sinking); fifteen in NZ waters (further than 5 km from mainland NZ); fourteen in the Pacific Ocean; and one in the Tasman Sea

## Contributing factors

A breakdown of contributing factors to water-based fatalities was limited due to missing data. Despite this, the breakdown is informative and is detailed in table 15.

Contributing factors	Number of Deaths	Percentage of Deaths
swept out to sea	35	30%
no life jacket	18	15%
alcohol or drugs	13	11%
medical	12	10%
jumping	9	8%
inexperienced	6	5%
rough	5	4%
unknown	4	3%
not a swimmer	3	3%
entrapped	3	3%
flooded river	3	3%
extreme sport (canyoning)	1	1%
collision	1	1%
mechanical	1	1%
weight belt too heavy	1	1%
caught in propeller	1	1%
<b>TOTAL</b>	<b>116</b>	

Table 15: Contributing Factors.

## Discussion

Participation rates for recreational boating are higher for males (35%) than females (22%) (Kalafatelis E. Buchanan, S., 2014). Expected NZSAR recorded deaths for males would be higher than females, however a death rate of 5% for females is significantly lower than anticipated. While the percentage of males is reported as 66%, it is likely the unknown data would increase this figure significantly. The Watersafe organisation presents similar numbers, consistently reporting that over the past seven years, approximately 80% of drownings are male (Drownbase, 2017).

Among those who do recreational boating, men have been identified as more likely to be experienced and to boat alone (Kalafatelis, 2014). Exploring the reason males are over represented

is beyond the scope of this report, however it is well accepted in the literature that males exhibit more risky behaviour than females (Harris M. Glaser, D., 2006).

The majority of boating deaths were as a result of the vessel capsizing. In a number of cases those involved had floatation devices and/or emergency position indicating radio beacons (EPIRBs), but were unable to use them because of the speed of the event. Once the boat was upside down and the occupants were struggling to stay afloat in the water, particularly if it was rough, they were unable to access them from the upturned hull. A recommendation to the EPIRB industry might be to manufacture a dual device capable of being located both by satellite, and by the vessel from which the person was lost overboard. This device might work in a similar manner to avalanche transceivers, which are carried by everyone in the party. The buried transceiver emits a pulsed radio signal, which can be detected by the other transceivers. A search grid strategy then draws the rescuers to the exact location. This might allow a yacht or ship to locate a crew member lost overboard.

Carrying the avalanche transceiver in a pack, rather than on your person, can result in failure due to the device not being accessible, or not in proximity to the victim if their pack is torn off. This is a similar issue to the EPIRBs being available, but not accessible after a capsize event. Avalanche transceiver manufacturers therefore recommend having them attached to your person, not stowed in your pack.

## Recommendations

- When boating, always wear a floatation device; put it on prior to getting onto the boat and only remove it once back on land.
- When net-setting or fishing, always wear a floatation device.
- Specifically target the Māori and Pacific communities in relation to water safety when engaging in traditional activities, such as gathering Kai Moana.
- An EPIRB or PLB be carried by each crew member, especially those engaged in blue water travel (more than 5 to 10 km off the coast).
- The skipper carry the EPIRB on their person, or a similar strategy to ensure it is available when needed. This would mean it was accessible post-capsize and still able to be activated.

## Wanderer events

A small proportion (11 out of 881 deceased cases) of the events lists on the NZSAR fatality database were associated with wanderer deaths. Wanderers were defined as people who were of impaired cognitive capacity, associated with age, special needs or dementia and who left their last location without permission of their carer. All wanderer events involved a multi-agency response with a 'large number of searchers' often reported. The time between the wanderer being identified as missing and the emergency services being informed varied widely, from almost immediately to five hours after the disappearance. This was not associated with the age of the wanderer or whether the wandering originated from a home location or elsewhere. Wanderers fell into two distinct age categories, children (45%) and the elderly (55%). Following thematic analysis, it was identified that both age categories were associated with distinct behaviour and terminology. Therefore each age group was analysed independently.

### Children

The children involved in fatal wanderer events were aged between three and 11 years of age, predominantly male, with 80% of Māori or Polynesian decent. Of the five child wanderers, three were known to be autistic. The language used to describe child wanderer incidents was distinctly different to that used to describe adults. Children were described as having 'run off' or 'run away', while adults 'walk' or 'wander'. Three were reported missing from their homes, while two absconded during recreational activities with their families. All were under the care of at least one family member at the time of their disappearance. All appear to be tragic accidents.

#### Location of fatality

All child wanderers were located in close proximity to their last known location. Eighty percent drowned in water hazards known to the child. These included a neighbour's swimming pool where the child had been previously located, and a disused open water tank. Accessibility was an issue, as three children drowned in unsecured or open water hazards. However, one child drowned in a locked, fenced private pool. The data would therefore suggest that local water hazards should be an immediate priority when searching for child wanderers.

### Adults

The adults involved in fatal wanderer events were aged between 64 and 87 years of age, male and were either of Māori, Asian or Caucasian decent. Of the six adult wanderers, all were known to suffer from dementia. All were reported missing from their family home or an aged care facility.

#### Location of fatality

Adult wanderers were located in a variety of locations, some within the immediate vicinity of their last known location, and others up to 22 kilometres away. One wanderer appears to have initially absconded by car, all others were on foot. One wanderer was reported missing with a friend (and fellow dementia sufferer), and although both were hit by a motor vehicle, only one was killed. All other adults left their last known location alone. One had a 'WandaTrak' pendant but was not

wearing it at the time of his disappearance. Fifty percent drowned after falling into water hazards. The remainder died as the result of accidental trauma or were not found.

## Discussion

Wanderer fatalities represented a small proportion of those contained within the NZSAR database, but resulted in a substantial investment of time and resources. All wanderer events, and especially those involving missing children, triggered a multi-agency response coupled with a substantial community involvement. Social media was often also used to alert the community and distribute information. All adult wanderers had impaired cognitive capacity, but there was no indication of negligence on behalf of those responsible for their immediate care.

While the narratives contained within the database are written with appropriate objectivity and detachment, there is a tangible sense of distress and disappointment at the death of a missing child. Although an occupational hazard, attending such events has significant mental health implications for attending personnel (Collopy, Kivlehan, & Snyder, 2012). Appropriate resources should be made available to NZSAR and emergency services personnel in order to manage the personal impact of being involved in such traumatic events.

## Recommendations

All hazards within the immediate vicinity of the last known location of a wanderer should be identified as priority search locations.

- Water hazards such as swimming pools, rivers or coastlines should be an immediate priority when searching for child wanderers.
- Inaccessible locations (such as well secured private swimming pools) should not be discounted.

Undertake further research comparing rescued wanderers with those ending a fatality to identify the following:

- Are current search techniques for locating wanderers effective?
- Is time between the disappearance and alerting the emergency services a factor in successfully finding missing wanderers?
- Are 'WandaTrak' pendants (or similar) useful in locating missing wanderers?
- Is distance travelled by the wanderer related to outcome?

Provide accessible mental health support for NZSAR personnel.

## Out-of-scope activities

Deaths attended by NZSAR that fell outside the remit of the study were given the broad definition of 'Out-of-scope'. There were 452 out-of-scope events, some with multiple fatalities, which represented 29% of deaths within the database. These fatalities were therefore the subject of demographic analysis to provide frequency data and context.

### Types of activity

The fatality events fell into seven broad categories: Disaster Victim Identification (DVI); Suicide; Outside the SAR geographic region; Aviation; Criminal; Commercial; and Unknown (Table 16). Of the seven subcategories, fatalities occurring outside the SAR geographic locations and those where the factors contributing to the cause of death were unknown were not subjected to any further analysis. This was due to the paucity of data relating to fatalities outside the SAR region, and small number of unknowns (0.4% of events). Fatalities were assigned to each category primarily on the basis of the person's activity at the time of death, or where this was unknown, on the basis of NZSAR involvement. For example, almost all suicides result in a body recovery, but not all body recoveries were suicides.

Activity	No. of Fatalities	Percentage of Out-of-Scope Fatalities
Suicide	187	41%
DVI	183	40%
Aviation	44	10%
Outside Region	25	5%
Criminal	8	2%
Commercial	3	1%
Unknown	2	1%

Table 16: Out-of-Scope Fatalities by Activity

Seven categories relating to OS events. Note that the number of deaths is higher due to multiple fatalities occurring for some events.

## Suicide

Events where the person voluntarily and intentionally took their own lives were the highest proportion of OS fatalities. In 88% of cases some form of categorical data was recorded, enabling frequency data on the cause of death to be identified (figure 17).

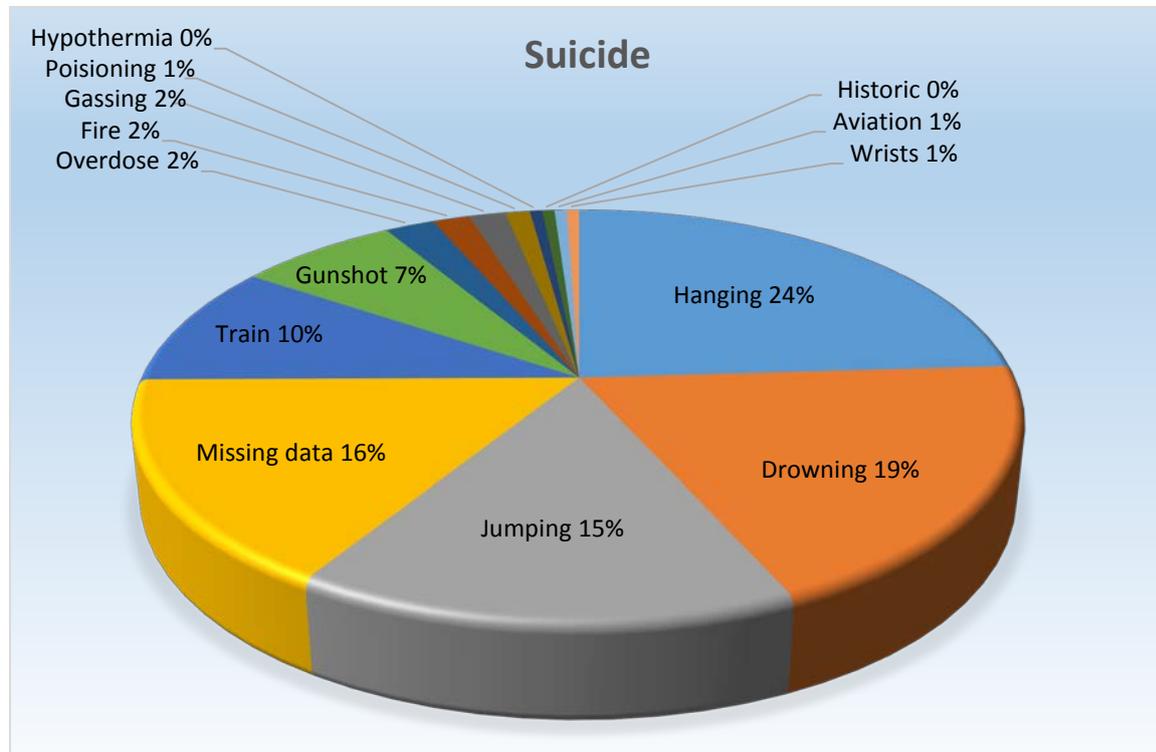


Figure 17: Cause of Death Relating to Suicide Events

Fifty five percent of people who died by suicide were aged between 35 and 64 years of age (Table 17). Seventy seven percent of suicides were male, 68% were of caucasian New Zealand ethnicity (Table 18).

Age group	No. of Deaths	Percentage of Deaths
0 - 14	0	0%
15 - 24	36	19%
25 - 34	21	12%
35 - 49	52	28%
50 - 64	51	27%
65 - 74	11	6%
75+	8	4%
Missing data	8	4%
<b>Total</b>	<b>187</b>	

Table 17: Age-group Data Relating to Suicide Deaths

Cause	No. of Deaths	Percentage of Deaths
Caucasian NZ	127	68%
Māori	16	9%
Caucasian other	10	5%
Asian	8	4%
Polynesian	3	2%
Middle Eastern	1	0.5%
Other	1	0.5%
Missing data	21	11%

Table 18: Ethnicity Data Relating to Suicide

## Disaster Victim Identification (DVI)

DVI represented the second highest category of out-of-scope deaths, accounting for 187 deaths from 183 attended events. Body recovery was named in 94% of DVI events, with body identification accounting for 2% cases requiring SAR involvement. The circumstances surrounding each DVI case are shown in figure 1.

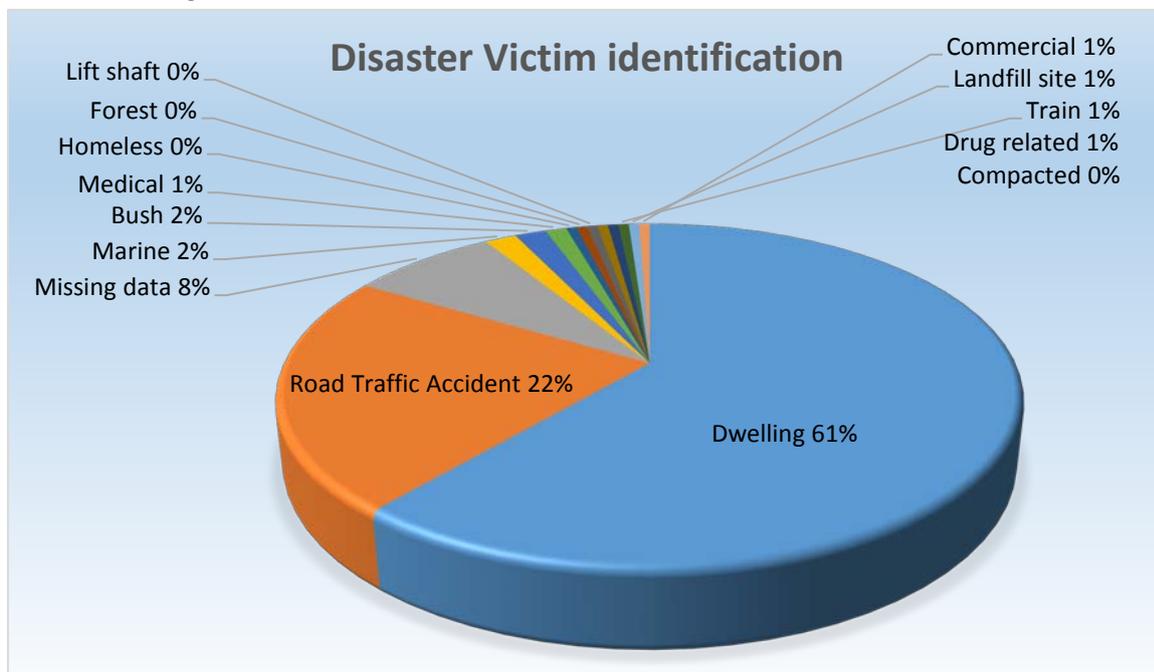


Figure 18: Circumstances Associated with DVI

Sixty three percent of people who required DVI attendance were aged over 50 years of age (Table 19). Sixty-nine percent of DVI fatalities were male, 47% were of Caucasian New Zealand ethnicity (Table 20).

Age group	Deaths	%
0 - 14	1	<1%
15 - 24	9	5%
25 - 34	7	4%
35 - 49	26	13%
50 - 64	52	28%
65 - 74	35	19%
75+	30	16%
Missing data	27	14%
<b>Total</b>	<b>187</b>	

Table 19: Age Group Data Related to DVI Deaths

Cause	No. dead	%
<b>Caucasian NZ</b>	87	47%
<b>Māori</b>	32	17%
<b>Caucasian other</b>	12	6%
<b>Asian</b>	9	5%
<b>Polynesian</b>	7	4%
<b>Other</b>	4	2%
<b>Missing data</b>	36	19%

Table 20: Ethnicity Data Related to DVI Deaths

## Aviation

Although all aviation incidents are investigated by the Civil Aviation Authority (CAA), NZSAR were involved in 44 aviation incidents resulting in 72 fatalities. Ground collisions accounted for 82% of events resulting in fatalities, with seven water and one mid-air collision also triggering NZSAR involvement. The type of aircraft involved in each incident is shown below (figure 19)

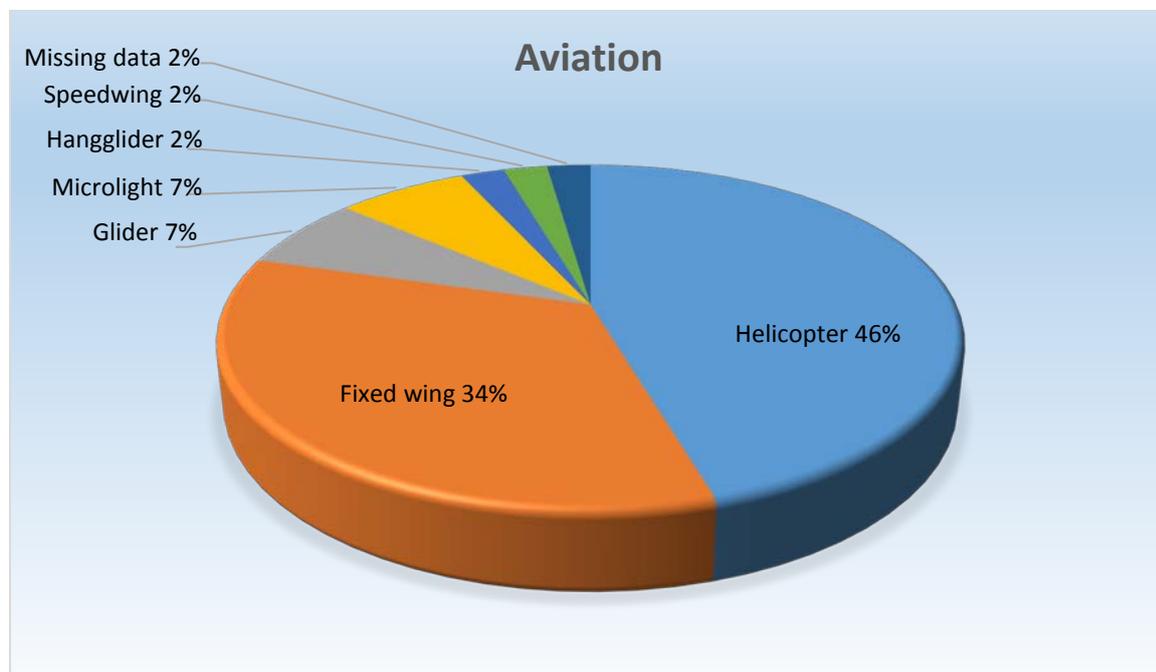


Figure 19: Type of Aircraft Involved in Aviation Incidents

Data collection relating to aviation incidents was not well completed, but this could be related to the understanding that all aviation incidents would be thoroughly documented and investigated by the CAA. From the data contained within the NZSAR database, Table 21 illustrates the age group data and Table 22 the ethnicity data for the 72 people killed in aviation incidents involving NZSAR.

Age Group	No. of Deaths	Percentage of Deaths
0 – 14	0	
15 - 24	0	
25 - 34	1	1%
35 - 49	5	7%
50 - 64	5	7%
65 - 74	1	1%
75+	0	
Missing data	60	84%
<b>Total</b>	<b>72</b>	

Table 21: Age Group Data Relating to Aviation Deaths

Cause	No. of Deaths	Percentage of Deaths
Caucasian NZ	15	21%
Caucasian other	1	1%
Missing data	56	77%

Table 22: Ethnicity Data Relating to Aviation Deaths

## Criminal

NZSAR were called to eight criminal incidents involving 11 fatalities. All fatalities were either homicides (88%) or resulting from illegal activities (12%), such as manufacturing methamphetamine. Demographic data pertaining to criminal deaths was limited, however, as with the aviation fatalities and the CAA, all criminal deaths are investigated by New Zealand Police. The knowledge of other agency involvement may explain why the data collected by NZSAR is limited. Little gender and ethnicity data was recorded (55% missing data), while documented age data is given below (Table 23).

Age group	No. of Deaths	Percentage of Deaths
0 - 14	1	9%
15 - 24	2	18%
25 - 34	1	9%
35 - 49	1	9%
50 - 64	0	
65 - 74	0	
75+	1	9%
Missing data	5	46%
Total	11	

Table 23: Age Group Data Relating to Criminal Deaths

## Commercial

Three deaths occurring while engaged in commercial activities involved NZSAR. One required body identification and the remaining two body recovery following commercial crush injuries in remote locations. All victims were male, aged between 50 and 64 years and of NZ Caucasian ethnicity.

## Discussion

The out-of-scope fatalities represented a large proportion of the total number of fatality events involving NZSAR. Of the seven broad categories that comprise the OS data, fatalities identified as suicides were the most prevalent, resource intensive and time consuming. Many involved extensive land searches involving NZSAR and community volunteers, body recovery from remote or inaccessible locations, or unpleasant and traumatising recovery of remains following impact suicides. NZSAR involvement was often triggered by reports of a missing person, eventuating in a suicide recovery.

However, not every potential suicide event involving NZSAR will end in a fatality. With only fatality data available, comparisons cannot be drawn between those events where a suicide attempt was successful, and where the person was found and rescued before death. Timely intervention following first suicide attempt has been shown to reduce the likelihood of second and subsequent suicide attempts (Brovelli et al., 2017) . Further research is required to explore any contributing factors that lead to a more positive outcome, such as time delay in reporting, resourcing, location, environmental conditions, along with the psychological and physical co-morbidities of the missing person.

Demographic analysis has identified an over representation of New Zealand Caucasian males in all out-of-scope subcategories where the data is available. Previous research has identified that men are at far higher risk of suicide than women (Freeman et al., 2017), which supports the NZSAR data, whereas little information exists on gender disparities among the undiscovered natural deaths requiring DVI.

## Recommendations

- Limit 'Subject behaviour' category to a select number of validated, useful terms.
- Undertake further research comparing the suicide fatality data with those found and rescued. Analysis of antecedent and contributing factors could create a framework for identifying more people with suicidal intention before a fatality occurs.

## Non-events

A significant number of events contained within the database triggered an NZSAR activation, but did not require NZSAR intervention. These were labelled 'non-events'. These included reported flare sightings, boats mistakenly identified as being in difficulty, and floating debris mistaken for any number of things. These incidents also include events where intervention was required, but was not undertaken by NZSAR (table 24). Of the total number of non-events, 86% were water-based, 13% were land-based and 1% were NZSAR or emergency services exercises.

## Outcome

Outcome	No. of Events	Percentage of Events
No outcome/event	337	75%
Self-retrieval	40	9%
Bystander retrieval	37	8%
Coastguard retrieval	23	5%
Paramedic retrieval	10	2%
Police retrieval	3	1%
Fire service retrieval	1	<1%
<b>Total</b>	<b>451</b>	

Table 24: Seven Categories Relating to Non-events

### Activity triggering 'non-events'

NZSAR activation which subsequently resolved into non-events were triggered by a number of activities or reported sightings. Boating and reported flare sightings accounted for 70% of all unnecessary NZSAR activation (figure 20), representing a colossal amount of resources deployed with no tangible outcome. Reported flare sightings were often subsequently attributed to Chinese lanterns, fireworks, airplanes or buoy markers. In fact, looking at the database as a whole, not one reported flare sighting was associated with an actual event. However, further analysis with the entire dataset, including successful NZSAR rescues, may demonstrate the usefulness of flares.

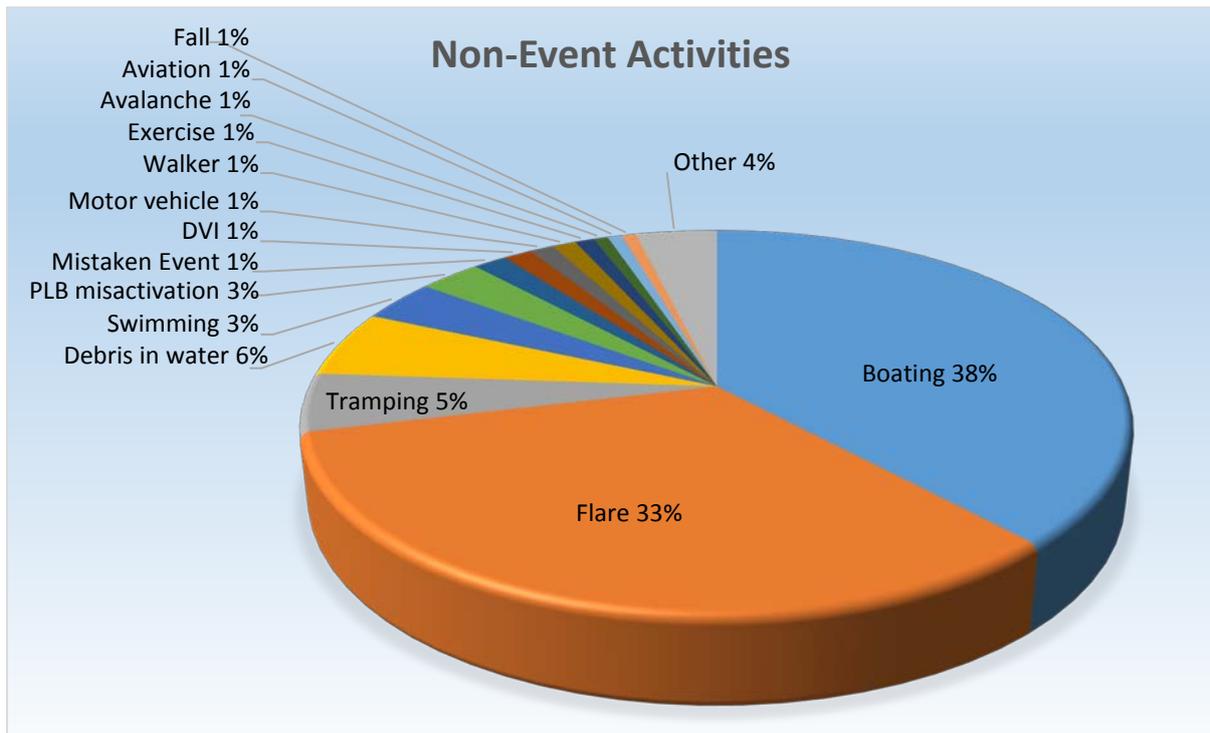


Figure 20: Activities Triggering Non-events

Thirty eight percent of non-events involved recreational boating, the highest number of non-events not involving flares. The factors leading to NZSAR activation when their services were not required are given below (Table 25).

Age group	Deaths	Percentage of Deaths
False alarm	66	39%
Adrift	37	22%
Mechanical failure	32	19%
Capsized	10	6%
Stranded	5	3%
Other	21	11%
<b>Total</b>	<b>171</b>	

Table 25: Factors Leading to NZSAR Activation for Boating Non-events

## Discussion

'Non-events' represented a large proportion of the total number of events triggering NZSAR engagement as contained within the database. Of the seven broad categories that comprise the 'non-event' data, flares and boating incidents accounted for the most activations, representing a significant allocation of NZSAR time and resources. Boating incidents were often resolved without NZSAR engagement, although without information on boating incident rescues, the importance of the NZSAR response cannot be underestimated.

Similarly, not every reported flare sighting triggering NZSAR involvement will end in a 'non-event'. With the available data, comparisons cannot be drawn between those events where flares triggered a successful rescue, and where a flare was reported with no outcome. Further research could identify the usefulness of flares and provide advice on educating the public on how to correctly identify a flare and how to react.

## Recommendations

- Undertake further research comparing non-event flare sightings rescued with events where flares were vital to a successful rescue.
- Create an educational awareness package to advise the public on how to correctly identify a flare and how to react.

## Summary of recommendations

### Public messaging

1. Specifically target the Māori and Pacific communities in relation to water safety when engaging in traditional activities, such as gathering Kai Moana.
2. When boating, always wear a floatation device; put it on prior to getting onto the boat and only remove it once back on land.
3. The skipper of any boat to carry an EPIRB on their person at all times. The EPIRB would then be accessible post-capsize and easily activated.
4. An EPIRB or PLB be carried by each boat crew member, especially those engaged in blue water travel (more than 5 to 10 km off the coast).
5. Use buoyancy devices when planning to engage in an activity on the rocks or on a riverbank, such as fishing, surfcasting or exploring cliffs.
6. Use buoyancy devices when net setting or fishing on estuaries or at river mouths regardless of the perceived water depth
7. Create an education programme around fall prevention for trampers, day walkers and mountaineers.
8. Create an educational awareness programme to advise the public on how to correctly identify a flare and how to react.

### NZSAR messaging

1. When searching for wanderers, immediate water hazards such as swimming pools, rivers or coastlines should be an urgent priority.
2. When searching for child wanderers, inaccessible locations (such as well secured private swimming pools) should not be discounted.
3. Ensure NZSAR staff have appropriate resources for managing the psychological impact of trauma.

### Database

In light of the volume of incomplete and missing data, recommendations specifically relating the data capture and any future iterations of the database are as follows:

1. Employ the main categories and subcategories as identified in this report as 'forced response' entries for every event.
2. Remove subjective classification choices relating to mental health or behaviour. Limit 'Subject behaviour' category to a select number of validated, useful terms.
3. Create individual matched fields for each victim within a single event, in order to capture accurate demographic data on all fatalities.
4. Fields relating to preparedness or equipment were very poorly completed, provided no meaningful data and should be removed.
5. Required specific information should be collected through 'forced response' fields (e.g. the use of lifejackets, PLBs, etc)
6. Fewer fields employing logic and forced responses could generate more useful, comprehensive, and meaningful data.

### Further research

By analysing NZSAR fatality data in isolation, comparisons could not be drawn between successful rescues and those resulting in a fatality. Factors unique to fatalities cannot be identified without

comparison to rescues in similar situations or circumstances. By comparing successful rescues with fatalities in each category and subcategory, specific and targeted messaging could be created to advise both NZSAR staff and members of the public. Further research using the complete NZSAR database should therefore:

1. Compare fatality data from all categories with data pertaining to successful rescues in order to fully understand the antecedent factors which contribute to a fatality. These factors include, but are not limited to: buoyancy devices; PLBs; preparedness, and intoxication.
2. Explore the causes of falls and the specific terrain in which most of them occur.
3. Investigate whether the current search techniques for locating wanderers are effective.
4. Determine whether the time between the disappearance and alerting the emergency services is a factor in successfully locating missing wanderers.
5. Explore the usefulness of 'WandaTrak' pendants (or similar) in locating missing wanderers.
6. Determine if distance travelled by the wanderer is related to outcome.
7. Compare the suicide fatality data with those found and rescued. Analysis of antecedent and contributing factors could create a framework for identifying more people with suicidal intention before a fatality occurs.
8. Compare non-event flare sightings with events where flares were vital to a successful rescue.

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