ABSTRACT: New Zealand has a unique combination of geographical position, terrain, weather and alpine users that makes forecasting, communicating and managing avalanche hazards as challenging as anywhere in the world. A national avalanche safety programme has been running in New Zealand for almost 40 years, managed and delivered by the New Zealand Mountain Safety Council (MSC) and their partners using multiple interlinking initiatives to increase the safety of people participating in the outdoors. Research and evaluation play an important part in the direction, ongoing development and funding of the programme. Although we may not know exactly how many accidents are prevented, the use of international research and consultation plus local evaluation allows us to reach some conclusions as to the soundness and effectiveness of the programme. In other words, while we don’t know how many shipwrecks does a lighthouse prevent? (Woodbury, G, 2005) good design and effective positioning gives us confidence that lives are saved due to these preventative measures.

The New Zealand Avalanche Programme has been developed over time by taking the most relevant ideas from around the world and applying them to the unique local situation by using McCammon (2008) Precaution Adoption Process Model. The model’s five stages of users and mediators of change have been used as a framework for linking these ideas to the local professional and recreational user groups. This combination of public outreach, social media use, education, backcountry advisories, an Info-Ex and strong sector engagement has resulted in a steady increase in the use, reach and effectiveness of the New Zealand programme.

KEYWORDS: avalanche programme, risk communication, mediators of change

1. INTRODUCTION

The New Zealand Mountain Safety Council (MSC) Avalanche Programme started in November 1976 with the first Avalanche safety seminar, jointly convened by the National Parks Authority and the MSC. Participants attended representing Land managers, scientific and technical organisations and mountain user groups for the purpose of discussing the avalanche hazard and organising a safety programme.

The outcome of this seminar was the formation of the Avalanche Safety Committee (later to become the Snow and Avalanche Committee – SAC) and two Task Force groups. One to work on research, planning and monitoring, the other group was to focus on field techniques for measuring and recording snowpack and avalanching and instruction in avalanche safety.

The programme has grown and developed over time by taking the most relevant ideas from around the world and applying them to the unique local situation with the overall goal of More people participating safely in the outdoors. This outcome is achieved through a series of overlapping preventative initiatives that are designed to give people the knowledge and information that they need to manage their own level of risk and make good decisions in the outdoor Alpine environment. These include research and monitoring of weather/snowpack conditions and avalanche occurrences; development and promotion of safety standards and guidelines, hazard and risk management information, publications, education and public outreach (Tbl. 1).

In 2010 the MSC Avalanche Programme was under severe funding pressure and the future of the programme was under real threat. A model was required to clarify the relevance and effectiveness of these measures, but it is very difficult to justify spending money on something that will, hopefully, never happen.
Over the previous ten years the fatality rate from avalanches had steadily declined and the ability to capture and record the involvements was very limited. To any potential funders the actual risk of fatalities to anyone but extreme alpinists looked very low.

It was critical to provide a structure for evaluating the performance of the programme content and answer the question of "Was it making a difference?"

Tbl. 1 The MSC Avalanche Programme content is divided into three distinct but overlapping categories.

<table>
<thead>
<tr>
<th>Education</th>
<th>Communication</th>
<th>Facilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avalanche Awareness Course</td>
<td>Backcountry Avalanche Advisory programme (website &amp; forecasters)</td>
<td>Snow and Avalanche Technical Committee</td>
</tr>
<tr>
<td>Backcountry Avalanche Course</td>
<td>Avalanche Advisory Signage.</td>
<td>Avalanche Education Working Group</td>
</tr>
<tr>
<td>Avalanche Risk Management Stage 1</td>
<td>The Crystal Ball industry periodical and newsletters.</td>
<td>INFO-EX (Avalanche information exchange website)</td>
</tr>
<tr>
<td>Avalanche Risk Management Stage 2</td>
<td>Publications: Manuals, pamphlets, Standards and Guidelines.</td>
<td>Research</td>
</tr>
<tr>
<td>Diploma in Avalanche Studies</td>
<td>Public Outreach: Talks, Events, Functions</td>
<td>MSC Branch network</td>
</tr>
<tr>
<td>Instructors (Qualified, current and revalidated)</td>
<td>Media Engagement: TV, radio, print</td>
<td>Council Member Organisations</td>
</tr>
<tr>
<td>Custom Courses</td>
<td></td>
<td>Related Organisations</td>
</tr>
</tbody>
</table>

2. THE NEW ZEALAND SITUATION

New Zealand has a unique combination of geographical position, terrain, weather and alpine users that makes forecasting, communicating and managing avalanche hazards as challenging as anywhere in the world.

2.1 Geography

Lying deep in the South Pacific Ocean, New Zealand is a long, narrow and mountainous country made up of two main islands and a number of smaller islands.

The South Island is dominated by a continuous chain of high alpine peaks (the Southern Alps) that run North-east to South-west almost all of its 840km length. Driven by tectonic uplift, the Alps rise from sea-level to their highest point, Aoraki/ Mt Cook (3,754 m/ 12,316 ft) within 50 km of the West coast (Fig. 2).

The North Island consists of rolling hills and ranges punctuated at its centre by a high volcanic plateau and three very active volcanoes. The highest of these is Mt Ruapehu (2,797 m/ 9,177ft) which has three ski areas on its slopes. Another volcanic mountain, Mt Taranaki (1,966m/ 6,450 ft) stands alone on a West coast peninsular just 26 km from the ocean (Fig. 1).

Fig. 1: A transect, 282km long, West coast to East coast through Mt Taranaki and Mt Ruapehu in the centre of the North Island (39.29° S).

Fig. 2: A transect, 162km long, West coast to East coast through Aoraki/ Mt Cook in the centre of the South Island (43.53° S).

2.2 Weather

New Zealand straddles the 40 degree south latitude, in what is known as the "Roaring Forties". The West coast is the first landfall for the prevailing, moisture-laden, westerly weather systems that have travelled over 20,000km (12,000 miles) of open water. Within 50kms of the coast the land rises to over 3000m (12,000 ft) creating substantial orographic precipitation throughout the year and bringing up to 8000mm (300in) of annual rainfall.

The low pressure zone, which circles Antarctica (Fig. 3) drives a constant westerly cycle of depres-
sions and cold fronts that are broken by ridges of high pressure that squeeze down from the sub tropics. This weather pattern follows an approximate 6-10 day cycle which is almost always accompanied by wind. In general New Zealand has a mild maritime climate but it is also exposed to occasional air masses from Antarctica, the southern oceans and tropical regions moving across the country.

The snow pack distribution is constantly fluctuating and decreases significantly east of the main divide. Large glaciers can be found down the length of the Southern Alps and on Mt Ruapehu in the North Island with average snow levels down to 1000m (3,280 ft) above sea level in the south and 1600m (5,249 ft) above sea level in the north.

The temperate climate and changeable weather create a heavily layered snowpack with melt freeze and rime crusts common. Direct action Storm slab avalanches or Wet slab from rain on snow are frequent during the storm cycles along with Wind slab deposited by the ever present wind. Persistent layers are generally associated with faceted grains around the crusts. The nature of the topography and the high precipitation rates can create large avalanche cycles that run to the valley floor throughout the Southern Alps.

Fig. 3: The Southern Hemisphere from above the South Pole. New Zealand straddles latitude 40° south and lays in the circumpolar vortex and low pressure zone.

2.3 Population

The majority of the 4.5 million people that live in New Zealand are concentrated in urban areas, at sea level and some distance from the mountain regions. Over the last 20-30 years the population has increased markedly through immigration from Asia, the Pacific Islands and Europe. Many of these new Kiwis embrace the New Zealand psyche of a can do pioneer attitude which romantically clings to an image of the great outdoors and national heroes like Sir Edmond Hillary.

Many people travel on weekends and holidays to recreate in the alpine regions unaware of the hazard that avalanches pose. There are numerous tramping, hunting and climbing clubs throughout the country, as well as a vibrant ski and snowboard community. 24 ski areas provide easy road access to public, backcountry, land via conservation estate and 8 National parks.

Fig. 4: New Zealand Fatalities by Activity 1990-2014

For a country of just over four million people the fatality rate of 1.6 people per year is relatively high, especially given that the numbers of people actually recreating and working in avalanche terrain is only a fraction of the total. But the potential for multiple fatalities in one event is very high and some significant near misses have been witnessed over the past few years.

The most at risk group in New Zealand is alpine climbers who make up over 50% of all recorded fatalities (Fig.4). Engaging with this cohort is a challenge on many levels and the content of the programme has been more focused on skiers and snowboards. This has seen a growing use of the products, events and courses by this group but work is being done to tailor the message to the climbing community.

3. BUILDING THE FRAMEWORK

The content of the MSC Avalanche Programme has been gathered over the years by utilizing many international components and best practice like the International Commission for Alpine Res-
cue (ICAR) guide for avalanche safety programmes and the Canadian, USA and European avalanche centres.

However, not only was it unclear How many shipwrecks our lighthouse was preventing? further critical questions required an answer. Things like How many ships were passing by? or What type? and Were they even seeing the light?

Given this lack of solid information on the backcountry users, a model was required that could provide a framework for linking the initiatives to the local professional and recreational user groups.

Ian McCammon’s 2008 paper on Out of Bounds users provided a Precaution Adoption Process Model that linked five stages of users and mediators of change. The five stages of users could also be related to the Department of Conservation Visitor User Group classifications. This had a positive impact when communicating with them as a sector partner and potential funder.

4. BACKCOUNTRY USER GROUPS

The Precaution Adoption Process Model used by McCammon (2008) links five stages of backcountry users to mediators of change that help to bring each group up to the next level of engagement and risk mitigation.

At each of these stages, people think, behave, perceive and manage risk in qualitatively different ways, and so the kinds of information that they need, and the interventions that will be effective, vary from stage to stage. This creates a significant risk communication challenge states McCammon (2008).

4.1 Stage 1: Unaware

Individuals have no functional knowledge of the hazard, and make no connection to local conditions or personal danger. Because they perceive no risk, they will generally pay little attention to or misinterpret warnings and will be easily influenced or may ignore decisional cues such as tracks and advice from other people.

4.2 Stage 2: Unengaged

Once people are aware that the hazard exists locally they may not believe that they are personally at risk. These individuals may comprehend warnings, but false alarms can easily lead to warning blindness.

4.3 Stage 3: Engaged

Once people are aware that a hazard might affect them, they are receptive to information regarding that hazard.

4.4 Stage 4: Emergent mitigator

People at this stage have actively sought out structured precautionary knowledge (avalanche training or equivalent), although they may be inconsistent in applying that knowledge.

4.5 Stage 5: Routine mitigator

People at this stage consistently recognize and effectively mitigate or avoid the hazards that exist.

The redeveloped New Zealand Avalanche Programme had initiatives to cater for all these groups to provide the most effective forms of risk communication and encourage them to move progressively to higher stages in the above model (Tbl. 2).
5. TARGETED INITIATIVES

Tbl 2: The Avalanche programme initiatives aligned to the five stages of user groups.

<table>
<thead>
<tr>
<th>Backcountry User Groups</th>
<th>Mediators of stage change and interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 5: Routine mitigator</td>
<td>Transceiver parks, Instructor pool, CPD, resources, mentorship, Publications (Crystal Ball, manuals). Professional avalanche training, Industry support (Standards setting bodies, Conference, resources, etc)</td>
</tr>
<tr>
<td>Stage 4: Emergent mitigator</td>
<td>Avalanche Danger Advisories (push techniques), Backcountry Avalanche Course, Decision making tools, Community creation (Membership, Public observers)</td>
</tr>
<tr>
<td>Stage 3: Engaged</td>
<td>Avalanche Awareness Course, Avalanche Awareness evenings/forums, Avalanche Advisory signage, Wholesaler/retailer buy-in, Member programme, Media engagement (TV, magazines, press), Social networks (twitter, Blog, U-tube)</td>
</tr>
<tr>
<td>Stage 2: Unengaged</td>
<td>Avalanche Awareness Course, Avalanche Awareness evenings/forums, Avalanche Advisory signage, Wholesaler/retailer buy-in, Member programme, Media engagement (TV, magazines, press), Social networks (twitter, Blog, U-tube)</td>
</tr>
<tr>
<td>Stage 1: Unaware</td>
<td>Social networks (create community), Awareness talks (Schools, Clubs etc), Avalanche Advisory signage, DVDs, posters, pamphlets for bars, ski shops, visitors centres etc, ATES, Events and functions, Sector engagement</td>
</tr>
</tbody>
</table>

6. CONCLUSION

Funding for a preventative programme has been difficult to attract. It is not easy to build a case for funding of What did not happen. If the programme is effective there is little to measure against.

We may not know "how many shipwrecks our lighthouse prevents? but we can evaluate the design and decision processes that lead to the specific placement of the lighthouse and come to some conclusion as to the soundness of these decisions without knowing whether ships did or did not crash because of them.

The design of the preventive initiatives that are delivered throughout New Zealand by the MSC are internationally tried, tested and shown to reduce injury and the loss of life. Since the 1950s European and North American scientists and educators have been developing hazard warning and training packages to better inform and prepare the public and professionals alike, to stay safe in avalanche terrain. Now over sixty years on we have a good understanding of what initiatives work best and on-going evaluation and revision of these programmes informs and drives the work that we do in New Zealand today.

The specific placement of our lighthouse has been guided by targeting the preventative initiatives to five general user groups, each with their own specific risk perception and engagement in managing their own risk.

By providing this structure to the programme we are able to evaluate the effectiveness of these interventions through feedback, surveys, focus groups and increased numbers of people accessing the information, attending courses and public outreach events.

We can confidently say that the MSC Avalanche Programme is identifying a need, applying a sufficient measure and having an effect on increasing the safety of people participating in the outdoors.

CONFLICT OF INTEREST

The author has not received any financial assistance from any organization apart from his employer when creating this document.

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