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Communication of Fire Danger Warnings in New Zealand and Overseas

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ABSTRACT

An important element of fire risk management is the communication of fire danger warnings. This report summarises a literature review of existing methods of communicating fire danger in New Zealand and overseas. Little assessment has been done in the past on how effective these methods are in changing behaviour and reducing ignitions.

Rural fire danger is communicated in similar ways in most Western countries through the use of fire danger signs located around the countryside. These signs indicate the current class of fire risk according to a calculated Fire Danger Rating. In addition to the signs, media campaigns are intended to provide backup and instruction on appropriate behaviour at different levels of fire danger.

There are various limitations to these systems, mostly relating to confusion amongst the public. Literature from a wide range of sources, such as risk communication, can be used to identify potential ways of improving the effectiveness of rural fire danger messages. The message needs to be matched to behavioural changes that the fire authorities are trying to encourage, and interpretation by members of the public must also be considered. The message itself benefits from being communicated through a variety of media in ways that acknowledge a diverse audience.

In the case of New Zealand, more attention needs to be paid to how effective the rural fire messages are at achieving the aims of the rural fire authorities (presumably fewer ignitions). At present, it would appear that the behaviour expected of the relevant public is not sufficiently clarified in the media campaign.

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1. INTRODUCTION

This report is the result of a literature review of existing methods of communicating fire danger in New Zealand and overseas, undertaken during a Social Science Research Centre studentship at the University of Canterbury from November 2005 to February 2006. It is part of a wider project that the Ensis Bushfire Research team is undertaking on communication of fire danger warnings.

Though the systems that most Western countries use to inform the public of fire danger and restrictions of fire use are fairly similar, very little assessment of the effectiveness of these methods in changing behaviour and reducing ignitions has been attempted. In this project, first the background and daily machinations of Fire Danger Rating and rural fire warning systems in general are explained, followed by examples and issues from around the world. Next, the results of a literature search on fire risk communication are outlined. These include various theories focusing on the aims of the person communicating the information, the interpretation of the receiver of the information, and also the message and media itself. These findings are finally applied to the issues surrounding New Zealand fire warnings systems and allow some suggestions for future research directions.

2. WARNING SYSTEMS AND FIRE DANGER RATING

2.1 Overview

The term 'warning system' refers to the method used to communicate risk (in this case, the risk of wildfire) to the public in order to change their behaviour or encourage them to take mitigatory action. In many countries, including New Zealand, fire managers are informed of wildland fire prevention and control needs by a Fire Danger Rating System (FDRS) that provides a measure of risk. These calculations are described as "a numeric scaling of the potential over a large area for fires to ignite, spread and require fire suppression action" (Brain and Schlobohm 2002). Basically, they apply local information about weather conditions (such as dryness and wind speed) and moisture levels to a set of complex equations that predict the likelihood of a fire igniting, fire behaviour and the ease of suppression. This results in a Fire Danger Index value (or values). This final number is translated into a fire danger class, which is then communicated to the public. The four to six classes relate to the adjectival rating that is indicated on signs, such as the 'half-grapefruit' rural fire danger signs, that are seen around the countryside (see Fig. 1), indicating low to extreme (or very extreme) fire danger. A detailed discussion of the methods and calculations used to produce fire danger ratings can be found in the works of Chandler et al. (1983), Alexander (1994) and Fogarty et al. (1998).



Figure 1: Fire Danger Signs from the United States.^{1, 2}

At the same time, most countries have systems of fire ‘seasons’ that regulate the use of fire by the public, both for visitors to rural areas and for farmers on private land. This is usually a triad, with an Open season, where the use of fire is unrestricted; Restricted, where a fire permit is required; or Closed or Prohibited, when a ‘fire ban’ is in force (see Fig. 2).



Figure 2: Fire season indicator signs from the New Zealand National Rural Fire Authority (NRFA).³

Signs are the main way in which fire danger is communicated to the public. However, these four to six categories of danger are somewhat ambiguous on their own, and are often used in conjunction with a media campaign (see Fig. 3). The media campaign, in theory, uses communication devices such as brochures, newspapers and television advertisements to include instruction on the specific behaviour expected of the public.

¹ <http://www.dof.virginia.gov/>

² <http://www.waymarking.com/>

³ <http://nrfa.fire.org.nz/equipment/signs.htm>



Figure 3: New Zealand's rural fire safety media campaign.⁴

2.2 Around the World: Systems and Issues

Australia, the United States, Canada and New Zealand use very similar general systems of fire danger rating and subsequent warnings. The New Zealand FDRS is adapted from the Canadian one, as similar climatic conditions are experienced in the two countries (Anderson 2005).

One major difference between New Zealand and these other countries is that Australia and North America have more complicated relationships with fire, making communication of this to the public more difficult. In New Zealand, native species are not adapted to the occurrence of fire and it is not considered a part of natural ecosystem processes. The majority of fires are “bad”, and it is more straightforward to promote the fire prevention message. In contrast, fire is a natural part of the ecosystems in many other parts of the world, and therefore some small-scale fires (including those purposefully lit to reduce fuel loading) are necessary to promote regeneration and to prevent large, catastrophic fires in the future. The smaller, low-intensity fires have a ‘cleansing’ effect on forests, removing the build-up of fuel (such as dead wood and litter) that accumulates over time (Teague 1991). Therefore, not all fires are “bad”, and fire managers have a more difficult task promoting the wildfire prevention message while still retaining the ability to carry out prescribed burning or to allow natural fires to burn to achieve fuel and land management objectives.

In New Zealand, fire is also used as a land management tool (for example, to burn off stubble to remove waste residues and sterilise the soil, or tussock to reduce woody weed encroachment, improve stock access and promote new pasture growth). However, these ‘burn-offs’ can get out of control, and the common negative perception of fire remains. Regardless of these differences, very little assessment of wildfire danger communication systems could be found in the literature reviewed as part of this study.

2.2.1 Canada

The **Canadian** Forest Fire Danger Rating System (Stocks et al. 1987) was developed (from circa 1920) from the analysis of large amounts of field data derived from weather, fuel moisture and fire behaviour statistics. This was then reduced to a set of equations and coded for computer (Chandler et al. 1983). These calculations result in fire danger classes that are communicated to the public in a similar way to those in the United States.

The mascot of the United States forest fire prevention effort is Smokey the Bear, as will be discussed in a later section. According to the Ontario Ministry of Natural Resources website, Ontario “and other Canadian provinces adopted Smokey Bear as their prevention symbol during the 1950’s. Smokey’s prevention message has been

⁴ <http://nrfa.fire.org.nz/>

similar in Canada and the United States, and in the past few years has matured to reflect the role of fire on the landscape”⁵. As in other places, fire danger and the need for caution is communicated to the public via highway signs indicating the level of danger, radio and newspaper advertisements and pamphlets/brochures.

Wildfire problems in Canada are complicated by the natural occurrence of wildfire within its ecosystem. According to the Canadian Forestry Service website “fire plays an important role in most forest ecosystems ... As these ecosystems have evolved over the last 10,000-15,000 years (since the glacial retreat at the end of the last ice age), fire has helped to maintain their health and diversity. From a socio-economic perspective, fire can however have negative or undesirable effects on public health and safety, property, and natural resources.”⁶

The Canadian attempt to educate wildland-urban interface (W-UI, known in New Zealand as the Rural-Urban Interface, RUI) dwellers about fire danger is called ‘Firesmart’,⁷ and factsheets about mitigation are produced under this heading. Some issues from Canada are dealt with in the following quotes from the Canadian Forestry Service website:

“Many people who reside in the wildland-urban interface have limited knowledge of wildland fire and do not fully appreciate its ecological significance, historical frequency, or potential intensity, or the limits of fire suppression. This means that the first and often most difficult step in addressing wildland-urban interface problems is raising awareness of the issue and motivating individuals and communities to act. Many people believe that “it won’t happen here” or “it won’t happen to me,” and when an interface fire does occur, they deem it a disaster. Through effective education and communication programs people will realize that “it can happen here,” but also that actions can be taken to minimize loss and avoid a disaster” (ibid).

“Agencies and organizations in Canada and around the world have developed many excellent brochures, posters, videos, and other materials aimed at educating the public about fire in the wildland-urban interface (W-UI). However, experience has shown that the most successful programs often involve personal contact and interaction. This includes, for example, hazard assessments conducted by fire officials with homeowners, or education programs run by community-based groups that allow information to be shared among neighbors and friends. Survivor stories have also been an effective way for residents to share how they were affected by a wildland-urban interface incident and to encourage others to act.”⁸

There is a lack of information from Canada on communication of fire danger ratings and associated expected behaviours, but as demonstrated here there is a wealth of information on problems related to the wildland-urban interface.

⁵ <http://affm.mnr.gov.on.ca/>

⁶ <http://fire.cfs.nrcan.gc.ca/>

⁷ http://fire.cfs.nrcan.gc.ca/research/management/wui/factsheets_e.htm

⁸ http://fire.cfs.nrcan.gc.ca/research/management/wui/challenges_e.htm

2.2.2 United States

The **United States** has created a FDRS similar to the Canadian one, although they were developed “more or less independently” (Chandler et al. 1983). One main difference between the two is that while the Canadian system was based on the analysis of empirical field data to create equations, the United States method involved the “mathematics and physics of fuel moisture and heat exchange”, and physical, laboratory-based experiments (Chandler et al. 1983). For a more in-depth description of this system, see Deeming et al. (1972) and Andrews (1987).

In terms of communicating the results of these fire danger equations to the public, a very successful prevention campaign dating back to the World War II is centred on the campaign’s mascot, Smokey the Bear. Smokey often appears alongside the fire danger indicator signs (see Fig. 4).



Figure 4: An example of a fire danger indicator sign from the United States.⁹

Smokey’s well-known message, “Only YOU can prevent forest fires” has permeated deep into the national psyche and contributed to an anti-fire sentiment. The campaign is described as the “most successful advertising campaign ever” (Jacobsen 1999, p. 19). However, changing policy towards fires requires acceptance that not all forest fires are bad and complete suppression not desirable. Increasing attention to fighting forest fires over the years has produced this problem: “the more effective [we] become at reaching and extinguishing fires when they are small, the worse the overall fire situation grows” (Greenlee and Sapsis 1996). Prescribed fires are also deliberately lit to reduce fuel levels and maintain forest health, to the bewilderment of some wildland dwellers who have an expectation of protection and the elimination of risk by their fire authorities (O’Laughlin 2005). Jacobsen (1999) comments on the poverty of the prescribed fire acceptance campaign when compared to the success of Smokey’s prevention campaign.

As a result, much of the education in the United States focuses on communities living in at-risk areas such as the W-UI. In these areas, much can be done to mitigate the effects of fire, such as clearing flammable vegetation from around homes (termed creating ‘defensible space’). A federal programme designed to deal with this is called the Healthy Forests Initiative.¹⁰ The programme is government organised but implemented on a state-by-state basis. This was launched in an attempt to address the problem of dangerous levels of flammable materials that have accumulated in

⁹ http://www.signsoflife.net/smokey_fire_danger.htm

¹⁰ <http://www.fs.fed.us/projects/hfi/>

forests because of an over-zealous fire-fighting regime over many years. The Healthy Forests Initiative attempts to deal with the obvious paradox within the United States fire regime: that communities must be educated about wildfire prevention while being convinced that some wildfire is necessary, and that it is usually necessary for prescribed fires to be deliberately lit. Also, some natural prescribed fires are allowed to burn, while their spread is monitored and managed. By combining a community focus with hazardous fuel reduction within one such positively-titled programme, an attempt is being made to channel public opinion. The National Fire Plan encourages each state to implement prevention and mitigation education, such as 'Firewise' programmes (similar to Canada's 'Firesmart') that involve working with communities to raise awareness.¹¹

Aside from this, a unique feature of United States fire danger communication is the use of 'Red Flag' warnings, which are used for "dangerous combinations of critical weather and extreme fire danger" (Saltenger, no date). This originally involved the display of a red flag on prominent buildings in the affected towns, in conjunction with a fire ban. The use of the term 'Red Flag Day' leads to heightened readiness for and response to fires. As elsewhere, public use restrictions are used when the fire managers see fit (Brain and Schlobohn 2002).

2.2.3 Australia

Australia also calculates short-term fire hazard through a FDRS, and then communicates a fire danger class to the public. There have been a number of systems in use in the various states, but the one developed by McArthur (1962) is identified by Chandler (1983) as being the most universally accepted. Like the Canadian system, this system is based on empirical data collected in the field (see McArthur (1962, 1967) and Cheney (1991)). Media campaigns then inform the general public of appropriate behaviour with fire, which is described by Emergency Management Australia as being very successful.¹²

Again, there is variation between the different states concerning the approach to restrictions. Fire bans are decided on a regional basis, and it makes sense that the fire danger be calculated separately, as the states are so large and varied. Concern is expressed in the Australian Fire Authority Council's (AFAC) draft report that the language and method used for communicating this information is not consistent across the country (Lawson 2005). This is a problem because of the "increasingly mobile Australian population", especially during the peak fire season of the summer holidays (Lawson 2005).

In South Australia there are 15 fire ban areas designated, and Dawson (1988) complains that the publicising of the fire danger classes "presumes that the public understands fire danger, will perceive an accurate message and will respond appropriately. The behavioural responses presumed include reduced fire ignition, increased human safety through evasive action and increased protection measures. However, although fire danger ratings are given great publicity by news media and roadside signs, it is probable that few people know what a specific fire danger means." Dawson (1988) reported that his 1984 review showed mass confusion. From 1982/83, a 'red alert day' concept was introduced (now known as 'Total Fire Ban' days), but apparently the effect of these was to expose the redundancy of the fire bans.

¹¹ <http://www.firewise.org>

¹² <http://www.ema.gov.au/agd/ema/emainternet.nsf>

Each state has fire ban days and restrictions that they apply over different fire ban areas. In Victoria, for example, the information related to what fire use is allowed can be found on the Country Fire Authority website (Country Fire Authority 2005). As in New Zealand, the information about exactly what is allowed under the different conditions requires searching for. Though information is distributed in leaflet form, this method of circulating information risks missing people. This is seen in Dawson's survey results (Dawson 1988).

2.2.4 Indonesia

There are increasing problems with fires in **Indonesia**, on the island of **Borneo**. During a severe drought in Kalimantan, Indonesia in 1982/83, "Kalimantan experienced the most extensive ever recorded forest fires. This was due to the fatal combination of climate and human presence, of opening up, logging and converting forests, of settlers and transmigrants from other overpopulated or poor islands, following the newly established roads, clearing, and trying to make a living" (Schindler, Bird and Yurda 1996). In East Kalimantan alone, around 3.5m ha of forest land was burned in 1982/83 – 35,026 km² - out of a total of 211,440 km² (a total of 16.5% of land area). The Ministry of Forestry "has designed a national forest fire prevention symbol, an orangutan, but other than that there is little or no adequate or effective campaign programmes for public awareness and concern over the danger of forest fire" (Schindler, Bird and Yurda 1996). Indonesia and other parts of South East Asia have since adopted the Canadian FDRS.

2.2.5 Europe

Forest fires are also a problem in large areas of **Europe**, especially the Mediterranean. Chandler et al. (1983) mention a few European examples, though only deals with the methods used to calculate fire danger, not the methods used to communicate the danger to the public. The Australian system has been used "operationally" in the Mediterranean region of Spain. Chandler et al. say that while some research has been done in the USSR, and various calculations tested (e.g. *Nesterov system*), use of these results is limited. The *Angstrom Index*, developed in Sweden and used in parts of Scandinavia, is one of the most simple systems in use. Fire danger is able to be calculated mentally under this system, which was also adapted for use in Portugal (Chandler et al. 1983). Many areas of Europe now also utilise the Canadian FDRS (Viegas et al. 1994).

2.3 New Zealand

The FDRS used in **New Zealand** is adapted from the Canadian system (Fogarty et al. 1998; Anderson 2005). There are five fire danger classes that translate to the five possibilities on the fire danger signs. The fire danger signs seen around the countryside are specifically intended for public education (Alexander 1994). The colours are standardised as much as possible, and the exact paint to be used specified by the National Rural Fire Authority (Dudfield 1993, see Fig. 5), differing from international approaches, such as in the United States, where the signs vary considerably.



Figure 5: The standard New Zealand rural fire danger sign.²

Alexander (1994) describes the criteria used to define classes used in New Zealand and provides an interpretation of the potential fire behaviour and resulting suppression difficulty associated with each fire danger class. The fire danger class is derived for different vegetation types (forest, grass and scrub) and therefore based on different criteria. Fire managers use the fire danger class to set fire season status, make decisions about the issuing of permits and to derive response systems. The public receives information of the current fire danger and the appropriate action to take from half-grapefruit signs and other media advertising the current fire season. In theory, the fire season controls the activities allowed in particular conditions, while the classes reflect day-to-day conditions.

According to Alexander (1994), however, the primary purpose of the fire danger classes is to notify the public of prevailing conditions: “the classification scheme is designed primarily for fire prevention purposes in connection with the general public (i.e. to inform the lay person of impending fire danger conditions so as to limit the number of potential ignitions)”. The fire danger classes are based on the concept of fire intensity as an indicator of fire suppression difficulty (i.e. how hard a fire will be to put out under today’s conditions). Therefore, the intention is to warn the public of increasing difficulty of controlling fires as the fire danger level increases, in the hope that they will be more cautious in their use of fire or with activities that might cause a fire.

The use of the fire danger classes by fire managers as the basis for a range of activities therefore appears to be at odds with the intent of the fire danger class criteria as outlined by Alexander (1994), and both of these are very likely at odds with the messages being received by the public as a result of seeing the fire danger signs and other fire prevention publicity.

The distinction between fire danger classes is a case in point, and remains somewhat mysterious to the casual observer. Alexander’s (1994) revisions suggested that a ‘Very High’ category be introduced to reflect the difference in suppression required between ‘High’ and ‘Extreme’ (Fogarty 1996). No justification for this was offered in terms of added effectiveness of fire danger communication to the public. In fact, the differences between the different classes of danger are only explained in very scientific terms and from the point of view of suppression. In 2005, an article in the *Southland Times* called “What the Colours Mean” attempted to describe this, but used technical language like “crown fires in exotic forests”, and “duff or humus layer.” This suggested that the fire danger signs are more useful to fire managers than to the public, as detailed descriptions exist of what each level of

fire danger means from their perspective, but this is not really on a level that will appeal to the public. It is not clear what, if any, communication benefits the 'Very High' category has. Anderson (2005) advocated that fire managers use intermediate readings for a more accurate picture of fire danger, such as the values of the individual codes and indices of the Fire Weather Index System (the key component of the New Zealand FDRS) for more specific fire information. Therefore, it seems unlikely that the fire signs are designed for the benefit of fire managers, especially since they are the instigators of the information. Though the signs are specifically meant to prevent ignitions by the public, the behaviour expected is largely left up to the interpretation of the viewer.

The general information to be gleaned from this is that Low-Moderate is relatively safe, and High-Extreme is dangerous. As a distinction between restricted and banned seasons of fire use already exists, it is hard to see what extra information the half-grapefruit signs offer. Dudfield advises that the term "fire danger" as opposed to "fire risk" is better, as it "is considered more emotive and better expresses the condition of the areas being reported on" (Dudfield and Hill 1993).

Furthermore, the distinction between fire restrictions and fire bans are often blurred as well. A news release by the Canterbury Regional Rural Fire Committee dated December 20, 2005 advised that "Christchurch City and Banks Peninsula have restrictions in place" (Canterbury Rural Fire Committee 2005). According to the website, the difference between a fire restriction and a fire ban is that in a restricted area "a permit is required from the relevant rural fire authority to light a fire in the open air" whereas in a ban "lighting of fires in the open air is not permitted" and "any existing permits would be cancelled."¹³ The news release went on to say, however, that "no fire permits will be issued from 21 December 2005 until 9 January 2006" (Canterbury Rural Fire Committee 2005), most likely due to office closures over the Christmas period. This is effectively a fire ban, but for some reason is still classified as a restriction.

New Zealand's multimedia rural fire prevention campaign is called 'C'mon, Keep it Green', and revolves around the main character, a fire manager named Bernie (see Fig. 3). Though many aspects of fire danger are touched on in some way, most of this information is through pamphlets or the internet which require active searching. The television and radio advertisements, which tend to penetrate to even the most passive of individuals, focus mainly on the message to dial 111 if smoke is seen, and do not, therefore, address the issues of the behaviour expected of the public at varying levels of fire danger.

3. HOW TO MAKE THE MESSAGES MORE EFFECTIVE

A fairly general search for literature on and theories of communication of risk resulted in ideas from several sources on how to make fire danger communication more effective. These were:

- The field of 'risk communication', which is a growing area. Most of the books devoted to this subject deal with the problems of informing residents of human initiated and controlled risk nearby, such as a nuclear

¹³ <http://nrfa.fire.org.nz/firebans/index.htm>

power plant, so that the risk is minimised without causing massive public panic or mistrust, however (e.g. Gough, 1991; Krinsky and Plough, 1988).

- disaster warning communications in general (e.g. Nielsen and Lidstone 1998; Mileti and Sorenson 1990).
- urban fire safety – theory and assessment of current practices and their effectiveness (e.g. McLean 1989; Kazakov and Johnson (BRC) 2005).
- a few references actually on rural fire danger warnings, which mostly consist of advice without much backup (e.g. National Rural Fire Authority 2001; Dudfield 2003).

Mayhorn (2005) says that to change behaviour, it is necessary to take into account the aims of the transmitter (the end result the communicator is trying to achieve; this can be subject to their own preconceptions and subjectivity), the channel (the medium through which the message is transmitted), and the receiver (the interpretation by the person receiving the information, which again can be subject to their particular knowledge and circumstance). It is following this advice that the information from all these sources was processed.

3.1 'Receiver' – Perception of Risk

3.1.1 Why is this Important?

According to the National Interagency Fire Centre's (United States) internet *Communicators' Guide* (Corney 2006), "the concept of risk communication not only addresses quantifiable risk, but also the public's perception of that risk, which may or may not be in sync with the "real" risk." Therefore, equating a certain amount of risk with a fire class is not particularly useful if it is not clear what action needs to be taken, because it requires people's interpretation of that risk and their subsequent actions will be variable. Because of this, the study of risk communication often begins with analysing the public's perceptions as receivers of information. The magnitude of risk citizens perceive affects the mitigative actions they take. This has been studied quite extensively with regards to the W-UI in the United States. Focus groups in Michigan studied by Reams et al. (2005) revealed that often "wildfire is perceived to be inherently uncontrollable, with random patterns of damage." This attitude towards the threat removed the motivation to action, as it was believed no difference could be made. This attempted to explain why many residents failed to take simple preventative action such as removing flammable vegetation from around their houses.

Several authors stress the importance of first examining public perception of wildfire risk for the purpose of communicating messages of wildfire safety, as the reasons they hold these perceptions is necessary knowledge in order to change them. As Beringer (2000) says, "Awareness and education regarding fire safety are important factors in bushfire prevention and at present there are few gauges of community knowledge of fire safety or their attitude towards bushfires. It is essential to determine the current state of knowledge and awareness in fire prone communities to be able to successfully focus and implement educational strategies for that community".

3.1.2 Perception of Risk in the Rural Urban Interface

Prescribed fire in the United States has created a unique situation related to residents' perception of risk. Many studies of perception of risk and its connection with fire information have been undertaken regarding RUI dwellers and mitigation that they can undertake. As said previously, fire messages can seem contradictory, while in reality the risk of wildfire damage can be dealt with quite effectively. This literature is from the United States, where the natural occurrence of fire in the forests causes greater risk and also complications with the use of prescribed fire. As suppression becomes less and less effective at preventing large fires (Greenlee and Sapsis 1996), a greater emphasis on self-mitigation for those living in rural areas has resulted. Fire managers recommend defensible space created around houses, and practical routine changes such as stacking wood away from houses. Perception of risk is important here as the more accurate the knowledge, the more focused and effective the mitigation efforts can be.

What Affects Perception of Fire?

Various factors have been identified as affecting hazard comprehension. Gardner, Cortner and Widaman (1987) list the following factors from previous research they consulted: education, income, age, length of time living in an area, and locational preferences. Added to this could be the nature of residents' relationship with the land. The knowledge and perception of fire risk of a farmer, for example, could be very different from that of an urban dweller.

In Gardner, Cortner and Widaman's study, which was devoted to discovering why the public has "not been receptive" to adopting programmes designed for their protection from fire, a questionnaire was sent to residents in Southern California, testing their hypotheses. They found that awareness of fire risk generally increased over time of living in an area, especially when fire is experienced close at hand. However, in the communities actually affected by the fire, the opposite can happen. A "dampening effect" is possible, due to the common attitude that "lightning does not strike twice in the same place" (Gardner, Cortner and Widaman 1987). It is recommended that education specifically target this phenomenon.

Other studies have reported the more logical, opposite effect of experiencing a 'close call' with a wildfire. Paradise, California, residents were "recovering from a pair of devastating wildfires in 2001", where 50 homes were destroyed. It was only after these fires that the culture towards fire prevention began to change (Berkshire 2004).

Another homeowner survey in Palm Coast, Florida, indicated that higher educated people felt less threatened, as did people with better insurance cover. Also, older people were more likely to perceive a high threat (and therefore to take mitigation measures) (Abt, Kuypers and Whitson 1990). Reams' study (Reams et al. 2005) reports quite contradictorily that support for mitigation increases after a fire, and that perceived fire risk is lower with older residents and people who have lived in the wildland-urban interface for a longer time (as they feel more experienced and knowledgeable).

While the threat perceived by very new residents was also low, Beringer, in a study on the residents of North Warrandyte (Victoria), Australia (2000), noted that knowledge improved after this initial ignorance, once literature on forest fire safety had been received. To him, this implied that "the education campaign is effective as once residents had received the literature they appeared to be more informed as to the risk of living in the area". This is positive not only because the higher the risk

perceived the more likely residents were to take action, but also because higher fire-related knowledge also equalled more realistic perception of risk and more effective mitigation action. Those who had “received literature, read the literature or had contact with the local fire brigade were more likely to have a better fire-related knowledge, including fire prevention” (Beringer 2000). He encountered a problem here, however, as often if residents believed they possessed adequate knowledge about the risk of fire, they were not interested in pursuing further knowledge, which was disappointing as the relevant literature is updated yearly (Beringer 2000).

What Perception of Fire do People Have?

Blanchi et al. (2004) have attempted to discover trends in perception towards forest fires using a survey in France, Spain and Finland. One thing measured is awareness of threat, and while the countries are compared to one another, no explanation is given as to why they think what they do or how it compares with reality. No analysis of the role of messages in this is attempted, and while it is recommended that more information is provided to residents in these countries, that is as specific as it gets.

As previously mentioned, some people see wildfire as uncontrollable and random, and therefore are much less likely to embrace prescribed fire as a tool. These people are more likely to not understand the need for prescribed fire. Apart from the issue of confusion in places like the United States, no studies that could be found have been undertaken on what people think of fire as a threat or a tool.

Different Types of Fire Safety Message

What is important in the examination of fire danger warnings is how different types of fire safety messages affect the perceptions people hold of wildfire. In a report on a study done on house fire risk in the United Kingdom, Lloyd and Roen (2001) noted that awareness of risk is affected by the relationship with those communicating the message. In this case, it was the firefighters (experts) explaining the risk to householders. “People are likely to respond better when the experts are less formal and friendlier in their approach” (Warren and Procter 2005). It is true that firefighters “enjoy an excellent reputation within the community and therefore have ready access to all sections of it” (HM Fire Service Inspectorate 2000), as observed in the United Kingdom.

Use of emotive language or sensationalism affects perception of fires and risk, and bad fire messages can do more damage than good. Hardy (2005) says that in the United States “media attention on towering “fire tornadoes”, the devastation of structures and communities, and the massive outlays of financial, human and mechanical resources have quite effectively obscured our perception of the complex and diverse nature of fire.” This can be seen in the career of Smokey Bear, which initially played on some quite nationalistic fears amongst Americans. The overwhelming message that fire is bad and must be stopped began with Smokey Bear during World War II. This took a nationalistic angle, as fearing that “future enemy attacks could spark widespread forest fires motivated forestry officials to cultivate the support of the American public in preventing wildfires.” Messages like “Careless Matches Aid the Axis” were promoted by the War Advertising Council (Jacobsen 1999, p. 19]. This was so successful that it has been very difficult to replace the anti-forest fire mindset with one that accepts prescribed fire. Expecting all fires to be fought and put out by officials interferes with the fact that fires occur naturally and that people settling in wildland areas should learn to live with fire and take their own actions against damage.

3.2 The Aims of the ‘Transmitter’

3.2.1 What Actions are Fire Authorities Trying to Encourage?

The next aspect of fire message communication that needs to be analysed is the transmitter, or what the person creating the fire message is trying to get the public to do. This is often not clearly defined (and complicated by the issues surrounding prescribed fire). O’Laughlin (2005) recommends agencies make it clear what they are trying to achieve and communicate this to the public. This creates a trusting environment and a more receptive audience. In the RUI case, fire authorities are fairly clear, saying wildland/rural dwellers cannot rely on fire fighters to come and save them (for reasons such as the long distances between the authorities and the residents and the number of people they have to help), so they must get personally involved in mitigation efforts. It has also been widely argued that the most effective mitigation efforts include community self-involvement (Bones 2005). In terms of casual users of wildland/rural areas, the needs of fire prevention authorities are to encourage the following actions: care with fire to prevent unwanted ignitions; knowledge of fire season restrictions; and recognising that fires starting in certain conditions cannot be contained or suppressed. Whether these needs are adequately expressed by advertisements such as signs and correctly received by the public has not been satisfactorily studied: it is just assumed.

3.3 How to Encourage Appropriate Action?

Using this information, how can messages be tailored in order to create the appropriate perception of fire for the actions required of residents and users of rural areas by fire managers? According to Nielsen and Lidstone’s article, “Public Education and Disaster Management: Is There Any Guiding Theory?” there are various instructions and advised methods, but no overriding theory on the subject (Nielsen and Lidstone 1998). The following two sections combine the advice from different sources to make suggestions about the channel and messages for communication.

3.3.1 ‘Channel’ – Most Effective Type of Media

A Variety

Throughout the literature on encouraging personal mitigatory action amongst RUI dwellers, the most common advice given involves the use of a variety of methods of communication and personal and community involvement. In the case of fire safety, the target audience is the general public. This wide range of audience types means that a wide range of methods is required. Reams et al. (2005) did a study of focus groups in Michigan intending to find out which programmes were effective in getting people to change their behaviour. Here, fire safety education and advice was communicated through the following: publications distributed through mailings; public events and websites to educate about hazard reduction; fire protection and safety; publicity in newspapers, on radio, television and through videos; and classroom teaching. The emphasis here was less on which of these methods was more or less effective, but rather the need to use as many different methods as possible to ensure adequate coverage (Reams et al. 2005). Porter (2001), reporting on the Canadian Firesmart scheme shares similar sentiments. This is also true for more general communications of fire danger. Most advisors recommend the use of a wide range of media coverage to ensure effective and thorough communication of warnings. These include the obvious examples, such as television, radio, newspapers, posters, signs

and the internet, but also more complex arrangements like community workshops and displays. The general philosophy behind this is that no one method reaches everyone, due to the many variables of humanity (Porter 2001). A NZFOA Rural Fire Report gives a summary of a survey taken of New Zealand forest owners on *Aspects of Rural Fire Control* (Pearce 2006). The results include the most common methods of fire prevention, plus a subjective assessment of the most effective of these methods. Local radio and forest signage ranked the highest. This assessment includes the use of individual and national campaign information, at both local and regional levels.

Radio and Television Commercials

Greenlee and Sapsis (1996) describe a study by Folkman (1975). This study aimed to document the use of these media by the public for the purpose of evaluating their usefulness for communicating wildfire messages, and combined this data with frequency of wildland visits and other demographics. Unfortunately, the article was not available to the author of this report and so the results cannot be used here. Greenlee and Sapsis also mention the work of Griessman and Bertrand (1967). This study found that “fire prevention messages were most commonly received through the mass media as opposed to through informal channels, indirect fire prevention through entertainment programs worked well, [and,] as a symbol, Smokey Bear is as well known as other national symbols” (Greenlee and Sapsis 1996). This confirms that communication that only requires passive attention (such as having the television advertisements on in the background) is effective at reaching those who will not necessarily seek out information themselves – often the least well-informed people. Television does have its limitations, however. In New Zealand, advertisements are limited to specific channels and targeted at certain audiences. This may impede the message uptake by other audiences.

Radio is considered less effective than television. Folkman (1979) is quoted by Greenlee and Sapsis (1996) as saying that radio was seldom recalled as being a source of messages, as opposed to television and billboards. However, radio is still worthwhile, as those that do not watch television are likely to have a radio. Radio is a key mechanism used for issuing hazard alerts and evacuation information, such as during Civil Defence emergencies in New Zealand and during bushfires in Australia. Radios, being usually battery operated, can be relied on to work in emergency situations where the electricity may have been cut off.

Signs

Greenlee and Sapsis (1996) also quote a number of studies that examine the use of signs in wildfire communications. One especially promising study is on *Improving Forest Service outdoor posters* by Colvert (1978), but this was unlocatable. Issues with the use of signs (such as the half-grapefruit sign) to communicate the level of fire risk include the distance needed to travel by fire managers to change the sign. Rural environments may mean the distance is too great for the signs to be updated regularly, causing the information to be out of date and leading to a lack of trust amongst rural land users. Signs are the most commonly recognised form of fire risk warning and certainly raise general awareness of the issue.

Public Education

While it is important not to assume that everybody is a willing participant in fire education and make sure the message reaches everyone, it is widely thought that personal, hands-on activities that involve whole communities are a very effective method of changing behaviour in the long term. Despite the recognisability of signs, it

is important to note the value of active and two-way communication as Fogarty (1995) explains in his summary of Beckingsale (1994). A sign or poster is an example of one-way or passive communication, while two-way requires some participation on the part of the receiver of information. Active participation in the transfer of information is much more likely to be effective and recalled later. In the case of RUI dwellers and motivating them to take personal mitigatory action (as authorities are not going to come and do it for them), community education programmes are particularly important, as the Community Fireguard (Beckingsale 1994) and Firesmart programme in Canada (Porter 2001) recognise. Boura (1998) criticises current attempts in Australia to raise public awareness and recommends community self-help groups as the most effective way of promoting long-term change. Boura's representation of the cycle of community education is shown in Figure 6.

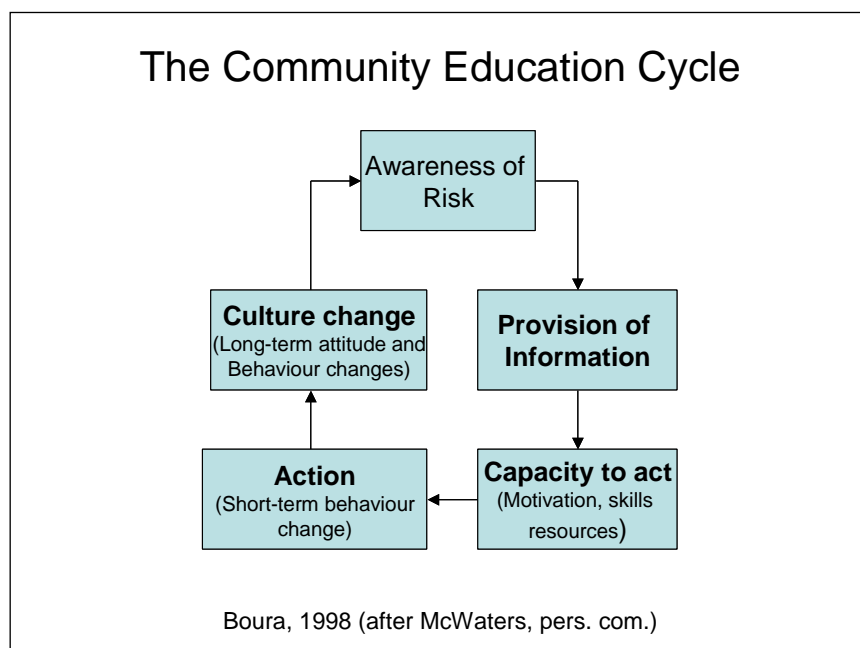


Figure 6: The Community Education Cycle (Boura 1998). It seems, however, that the process of education is less of a cycle than an evolution, as more and more information is added to enhance awareness (see Figure 7).

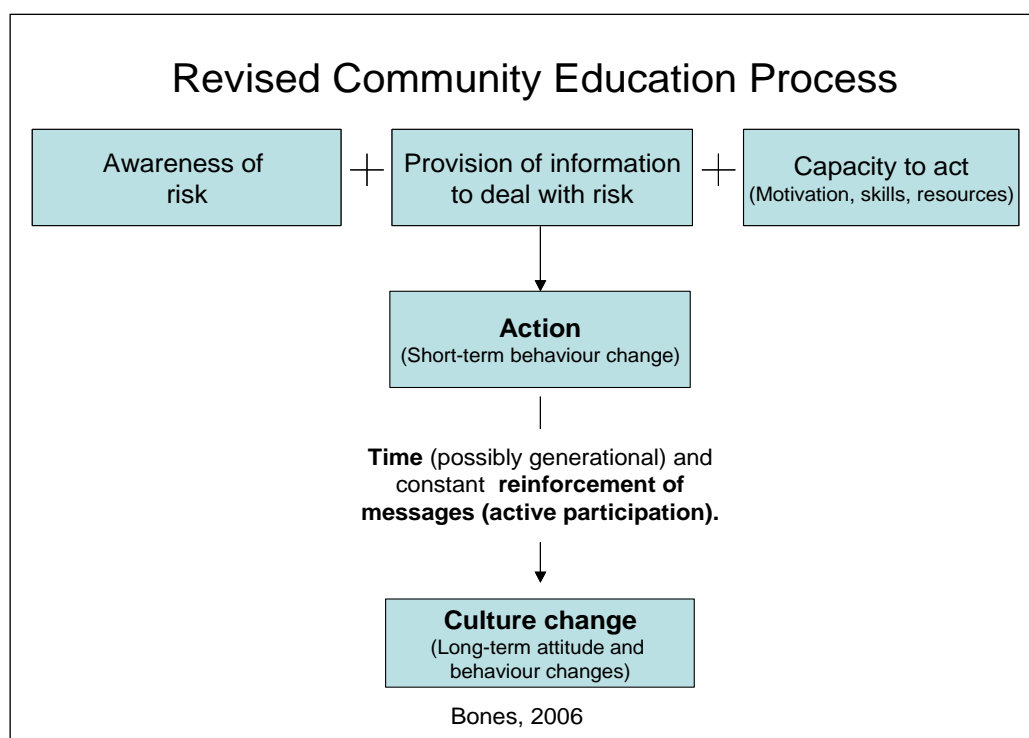


Figure 7: Revised Community Education ‘Cycle’ – Community Education Evolution.

Utilise Existing Channels of Communication

While the multi-media approach is desirable, it has been suggested that the use of existing channels of communication is a good idea, both because of the added efficiency of using an already existent and previously untapped resource, and the added effectiveness that this brings. A leaflet included with the electricity bill, for example, or a message on the bill itself requires no effort on the part of the receiver (Valen 1997). To expect people to actively seek information, such as visiting a website or District Council Office, instantly limits the audience to those who already care enough to do so, thus missing the primary targets of the campaign (those who are unaware or unconcerned).

Personal Contact

As said previously, Warren and Procter’s (2005) study on house fire risk awareness revealed that personal contact with friendly fire authorities can be more effective than orders from authority. They say that there is a need for more direct communication between fire managers and community members, rather than just relying on instructions and science. People trust fire safety programmes more if “they are given clear messages, presented by credible individuals who specify necessary actions, and provided the messages are reinforced locally” (Warren and Procter, 2005). Fire managers need to be seen as authorities, but accessible ones.

3.3.2 The Message Itself

Accurate – Creating Correct Perceptions

It is important that fire messages are relevant and accurate. Firstly, an obvious lack of accuracy can induce mistrust and non-compliance and complacency. An example of this could be a half-grapefruit sign indicating extreme fire danger on a rainy day. This can induce a lack of faith in the system, and reduce the effectiveness of the message. Secondly, misinformation creates an incorrect perception of fire danger, and therefore does not promote the correct action. The media often uses scare-mongering tactics to raise ratings; this is not helpful as an overwhelming fear of a fire disaster can result in hopelessness and a feeling that nothing can be done, and in appropriate action not being taken. Recent examples from the 2005/2006 summer in Canterbury include dramatic headlines like “Wild Weather” (Scanlon 2006).

Motivation – Take Obstacles into Account

A problem with visitors to wildland or rural areas is that they may have no personal investment in the area. It is much easier to convince rural landowners of the need to be careful with fire if they are threatened with the loss of property, possessions and lives. Some sort of motivation needs to be found. Brown and Davis (1973) state that there are some people that are motivated by nothing except the threat of punishment, so this is why harsh penalties need to be enforced for carelessness with fire.

It may be true that being threatened personally by a wildfire or seeing another mitigation effort being successful would motivate RUI dwellers to implement mitigation efforts. However, this might not translate so well to preventing ignition of fires. Unfortunately, visitors to rural areas often do not have the same personal investment in the area, so can throw burning cigarettes out of the car window with very little concern. As a result, a reason must be found for the behaviour change that benefits the person making the change.

There are often other obstacles that need to be overcome as well. In the case of urban fire safety, one thing preventing people from installing smoke alarms is poverty (Warren and Procter 2005, p. 35). A campfire can be a lot cheaper than an expensive gas barbeque, so can seem like a more appealing option. Not just the danger but the long-term investment quality of the safety measure needs to be emphasised.

3.3.3 Proof – That Action Leads to Effect

Seeing that mitigatory efforts are effective, for example if a neighbouring town sets a good example, is a great motivating factor. According to Magill (1994), who presented a paper at the Biswell Symposium in California in 1994, warnings need to be “proven effective, ... clear, specific for the desired response [and] derived from a credible source.” For example, the Firewise programme in the United States was very successfully introduced in places such as Southern California where a fire had threatened Stevenson Ranch, a sub-division. This community had such effective fire mitigation measures in place that not a “single life, nor a single structure was lost” (Berkshire 2004). Following this example, when it had been proved to people how effective these measures were, a great increase in people adopting them was seen. Techniques for activating homeowners to mitigatory action is also discussed by Fogarty (1995).

3.3.4 Tailored to Needs of Different Audiences

It is important to take into account differences in demographics, and use varied messages to suit different audiences. As well as the method of communication requiring variation, some recommendations advise against relying on a central, standardised message. Downing (1997), reflecting on difficulties caused by severe fire conditions in 1996 in Southwest United States, blames the huge problems caused by human-caused fires on the inflexibility of the fire safety message. Here, each group of forest managers faced a unique situation, as ethnic diversity and the large numbers of tourists passing through meant a varied interpretation of and response to warnings. Pearce (1997) says “the greatest handicap to fire prevention education is the difficulty of reaching all the people responsible for fires.” Corney (2006) works for the National Interagency Fire Centre in the United States. In an online resource called the *Communicators’ Guide*, he advises gaining knowledge of the intended audience of messages. The content of the message can then be tailored to fit the specific audience. He says that “knowing the attributes of the audience will dictate what type of message to send, and what type of language to use.” Perhaps, in the case of television, the demographics of the programming at various times could be used to tailor fire messages to the specific audiences more effectively (though of course this would be a lot more expensive than just one generic message). Different audience members have vastly varying requirements that need to be taken into account.

In contrast to this, many critics of warning systems call for a more consistent fire safety message system. For example, in Australia, a 2004 report commissioned by the Council of Australian Governments called the *National Inquiry on Bushfire Management* calls for a consistent nationwide education programme to be established, as variances between states and areas means that an unpredictable coverage results (Ellis, Kanowski and Whelan 2004).

These two positions are not incompatible; while the fire safety message needs to be flexible to allow effective communication to an eclectic group of people, a consistent approach can still be found over a country scale. One homogenous message is obviously limited; the Smokey Bear website proudly boasts that Smokey’s fire prevention message remained unchanged for 50 years until April 2001, but the limitations there are quite clear. However, visual signs need to be instantly recognisable, so consistency in presentation is necessary. The warning signs in the United States vary considerably from the more usual half-grapefruit idea to completely different layouts (see Fig. 1 in section 2.1).

There are many different groups in society, and those that do not respond so well to the most standard of messages are also often the most at risk, such as those with a language barrier or elderly people. For example, in communication with the elderly there are a range of factors not present elsewhere in society that need to be taken into account. Eyesight is often a problem, so large-sized print is imperative, and also some colour combinations are more “elderly-friendly” (Mayhorn 2005). Another sight issue that could be addressed is colour-blindness. The same is evident for hearing, and certain frequencies of radio broadcasts can be more easily heard than others. Then there are cognitive issues; Mayhorn (2005) says that working memory (temporary storage) declines with age while semantic memory (facts accrued through a lifetime of learning) does not. Therefore, use of simple sentence structures that build on what people already know is more effective for elderly people than long, complicated instructions (Mayhorn 2005).

Also, special attention can be paid to the groups most likely to cause problems, according to McLean (1989). He recommends defining the target audience: “who causes the problems, what are their behaviour patterns, what do they know and what do they believe about forest fires.” The targets in this case are said to be recreational users of forests and motorists (McLean 1989). This does happen in New Zealand, where the target audience is said to be males between the ages of 15 to 24 (Dudfield 2003). The danger is that if the information is too specific to one group, it will bypass the majority of the population. The possibility that publicising fire danger may activate potential arsonists has been suggested (Matthew Willis, pers. comm.), but the positive aspects of publicity must outweigh this possibility.

3.3.5 Structure

Simple

It is widely recommended to keep messages simple, as long or complicated screeds of information will in most cases cause the receiver to tune out and remember nothing of what they have heard (Corney 2006). Corney (2006) also states that at the same time, “interpretation requires streamlining and condensing a large amount of complex information.” If the information is too simplistic then the audience will notice gaps and become mistrustful. It is best to assume no technical background on the subject – even if some detail is lost, it is important to “keep the audience’s frustration to a minimum” (Corney 2006). This does not, however, mean patronising the audience with a child-like level of wording. This will also have a negative effect.

Repetitive

Repetition of key words and phrases is imperative to achieve retention of information. The success and longevity of Smokey’s catchphrase, “Only YOU can prevent forest fires” is testimony to this advice.

Build on Current Knowledge

Corney (2006) advises communicators to “link new information with concepts that are already known by the audience, thus providing a reference point by which the audience can grasp the new concept and connect it with something familiar.” This linguistic concept is called the “given/new principle” (from Brown and Yule (1983)), which says that “information that is not easy to grasp should come only after ample lead-ins describing the context in which the new information sits” (Corney 2006).

Tone of delivery

Corney’s advice (2006) for the tone used to deliver fire messages recommends that “impartial tone and deference to the larger community of scientists, policy makers, and the public ... be projected”. The use of the passive voice is helpful, as “an announcement about the subject of a sentence made after a passive verb construction tends to sound like an established and accepted statement, rather than a bold, new conjecture” (Corney 2006). He also advises managers to recognise and dispel common misconceptions. Further instruction on effective communication can be found in Schaenman’s book (Schaenman et al. 1990).

4. APPLYING THIS ADVICE TO NEW ZEALAND

Critical assessment of the effectiveness of current fire danger communication in changing behaviour to prevent forest fires is virtually non-existent in New Zealand.

A study in 1998 by CM Research on public awareness of fire safety surveyed 500 New Zealanders by telephone and found that 89% of people surveyed reported seeing "Fire Hazard" signs in the area. A total of 76% said they were more careful when the danger was High or Extreme (CM Research 1999). This report has a rather positive tone, however, which does not appear to be justified. The report reveals that 86% of people have noticed Fire Hazard signs in rural areas. This is used as one indicator for the conclusion that "public knowledge of fire safety and prevention issues is relatively high." There is no interrogation of the information gleaned from the Fire Hazard signs, or what behavioural changes are made, save for the 76% of the 89% (68% of total respondents) who say they "take more care" when the signs say 'High' or 'Extreme'.

A similar limitation exists with another study by CM Research who were commissioned by the Fire Service to evaluate the effectiveness of an advertising campaign on house fire safety in 2000. The results show quite a low awareness of fire safety messages among the people surveyed, but concludes that the "research results are very encouraging", as the awareness was consistent across all demographic groups indicating that "the campaign has touched all sectors of society" (CM Research 2000). The survey reached 500 "New Zealanders" and a further 100 "Maori and Pacific Islanders." The campaign had definitely reached some people in each demographic group, but the recall rate was still quite low, with figures such as 29% of Aucklanders recalling the campaign. It would seem that questioning of the effectiveness of fire safety campaigns is limited, or not readily available to the public.

4.1 Risk Communication

It is important that any assessment of rural fire warnings takes into account both the aims of the 'transmitter' and the interpretations of the 'receiver'. Rural Fire Authority managers are presumably trying to promote the safe use of fire amongst visitors to rural areas, who may be unfamiliar with the conditions that they are faced with. While it is fairly clear what the procedures are during a fire restriction or ban (a small amount of research on the internet - the NRFA website, under 'Fire Season', for example - can answer questions about what kind of fires are allowed), the expected behaviour change relating to the five fire danger classes is unclear (as Dawson (1988) complained in Australia). A paper by Alexander (1994) argues the importance of having five classes of fire danger, and introducing the 'Very High' category, but his reasoning for this appears to have very little relevance to the perceptions and needs of people in rural areas. His reasons relate to the use of this information by rural fire authorities about fire conditions, but as the fire authorities are the ones communicating this information to the public, it seems strange to target the information at them. For the public, there is little to indicate the difference between a Very High fire danger and an Extreme fire danger. From fire danger signs, there is no evidence of consideration of the aims of the transmitter of information or the possible effects on the behaviour of the receiver of the message.

In terms of visual consistency, however, the New Zealand fire danger signs are exemplary. Where in Australia and the United States there is no consistent design for danger signs, in New Zealand they are strictly standardised. Alexander's report (1994) considers this, and recommends replacing the "current menagerie" of signs with a "common roadside display board which can be recognised throughout the country." This has happened even down to specific brands and colours of paint being used: the Very High category requires Resene 'Tangerine' 10R40 paint (Walker 1993). As a result the signs are an instantly recognisable symbol. Alexander (1984) also recommended removing all fire danger signs during winter, and replacing them at the start of summer to increase impact. It seems, however, that this might simply cause more confusion, and that accuracy and public confidence are the important things.

4.1.1 The Message

The prevailing message of the television and radio campaign (C'mon, Keep It Green) focuses on getting people to call 111 if they see smoke. While it may be successful with this, the advertisements portray a fire manager called Bernie racing round the country changing fire signs. Without any emphasis on personal responsibility, there is a danger of creating the perception that someone else will deal with fires lit deliberately or accidentally. This message is limited in terms of addressing the wider goals of fire authorities.

Clarity about the differences between restricted seasons and fire bans is needed. A restricted period is defined as one where a permit is required for lighting most types of fires. However, there are times in mid-summer when fire authorities choose not to give out fire permits, as discussed in Section 2.3. It is often far more complicated making management decisions than the public realise, but if a perception is created that fire authorities are not being entirely honest, they risk non-compliance. Authorities might be reluctant to implement fire bans because of the negative reaction land owners might have through being prevented from going about their business. The 'red alert' and 'Red Flag' days from Australia and the United States might be more publicly accepted, as the word 'ban' implies the control of fire authorities. The removal of this word creates a perception of extreme conditions beyond anyone's control and perhaps would be more easily accepted. The five classes of fire danger currently give little more information to the public about what they should be doing than the restricted/ban distinction indicates. Fire seasons and restrictions are used to limit activities due to general climate trends, while Fire Danger Warnings communicated through half-grapefruit signs are there to reflect day-to-day conditions, and let the public know what is different (and potentially troublesome) about fire danger today as distinct from yesterday.

4.1.2 Motivation

It is necessary to analyse the motivation needed for action for effective risk communication. There is a problem with casual visitors to rural areas not having the same personal investment in the area that residents might. As well as appealing to a sense of public duty and values connected with preserving beautiful New Zealand countryside, perhaps some way could be found that it personally affects visitors. As Brown and Davis (1973) mention, some people only respond to the threat of punishment, so perhaps legislation in this area needs to be looked at as well. This is, however, a somewhat negative approach. Perhaps more publicity needs to be given to ensure that the public is aware of the fact that a person who is found to be

responsible for an accidental or deliberately lit fire will be held liable for the cost of controlling that fire, and this can amount to a huge sum (Forest and Rural Fires Act 1977).

The fire danger signs are supposed to represent general fire conditions, and not small fluctuations. Therefore, often fire managers are disinclined to change a fire sign to low even if it is raining, because visitors might think fire use is not restricted. This causes mistrust and confusion in some people, who tend not to believe any fire warnings if it appears that no-one adjusts them at all. This is exacerbated by the use of signs by fire managers to reflect seasonal (and fire season status) conditions, rather than day-to-day fire danger conditions as intended within the system. Further problems are caused by the logistics of staff availability and travel distances that may prevent these changes happening as often as they should. It is difficult to see how to remedy this problem, except to include in the fire messages a line or two about how the fire danger can still be very high in wet conditions, as it takes a lot of rain to change the ground moisture content. If fire managers are rigorous with changing the signs, and the public trust that this will happen, the message will be far more accurate and effective.

5. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

As it is important to ascertain the aims of the transmitter and find out exactly what the required action is, a survey of fire managers would be of great benefit. This will reveal whether or not they have been directly thinking about this, and if the methods they are using to convey fire danger could be better designed to meet their needs. From here, the public's current perceptions of fire risk, and therefore the effectiveness of signs and media campaigns, could also be measured. Finally, advice from this report and others on effective communications could be applied to these two measurements, resulting in maximum achievement of the goals of fire authorities.

As said previously, a useful focus for research could be to analyse the differences in awareness of risk and perception between rural dwellers, urban visitors, and RUI residents.

There is a lot of room for improvement in fire danger communication in New Zealand. While the fire danger signs are a recognisable piece of the New Zealand countryside, the principles behind them need to be subjected to much more interrogation about their effectiveness from a social perspective. The media campaign, while satisfying the need for a consistent figure and layout to become entrenched in public memory, seems to miss the most important aspects of the fire message that need to be delivered. The overall fire prevention objective would also benefit from clarification of the links and distinctions between the national campaign and fire danger warnings as portrayed through fire danger display boards (and other publicity).

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