ORIGINAL RESEARCH

An Analysis of Sea Kayaking Incidents in New Zealand 1992–2005

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Objectives.—The objective of this study was to investigate trends, medical problems, and contributory factors that occurred in 50 sea kayaking incidents in New Zealand between October 1992 and September 2005. There are currently very limited validated data available worldwide about the epidemiology of sea kayaking incidents. The research will raise awareness of how these events happened and their potential for serious harm. It will assist kayakers to manage their sport safely.

Methods.—This was a retrospective epidemiological study of incident reports originally collected by Paul Caffyn for the Kiwi Association of Sea Kayakers (KASK). Variables investigated in this study were geographic location, month, year, participant demographics, incident severity, type of kayak and trip, environmental conditions, safety gear carried, medical problems, cause of deaths, and contributory factors. Tables and graphs were developed to analyze the results.

Results.—Incidents occurred around New Zealand throughout the year, often in rough seas in offshore winds. More people were involved in September. Fifty-six percent of incidents involved groups; 20% were overseas tourists and 72% were recreational private trips. Eighty-five percent of participants were male, mostly aged 24 to 39 years old, and 48% had little or no experience. The severity of incidents increased with time. Severity was lower for women. Severity was higher in calm conditions and light winds, when the capsized kayaker became separated from the kayak, and when a personal flotation device (PFD) was not worn. Fishing incidents had a higher severity and involved inexperienced kayakers. Human factors contributed to most if not all incidents and occurred more frequently than physical events. Where medical problems were reported, hypothermia and sprains were common. Collision with a powered vessel was often fatal. The study was limited because it was based on relatively small numbers, was unlikely to capture all incidents in New Zealand, and denominator data were unknown.

Conclusions.—All incidents were complex events with many variables interacting in different ways and all had the potential to be serious and life-threatening. Human actions were more important than physical events and young men were most often involved. Staying with the kayak after capsizing and wearing a PFD may have reduced the severity of an incident.

Key words: sea kayaking, incident, severity rating, contributory factors, medical problems, New Zealand

Introduction

There is a scarcity of published research into factors contributing to sea kayaking incidents and associated medical problems. The American Canoe Association published a review of all kayak and canoe fatalities in the United States between 1996 and 2002.¹ However, that

research did not differentiate between types of kayak and was restricted to fatal incidents. Injuries to white-water kayakers in some western US states were studied by Fiore and Houston in 2001,² and Fiore subsequently reviewed the demographics of kayaking and rafting white-water injuries in 2003.³ Maritime New Zealand is the Crown Entity in New Zealand responsible for investigating and analyzing maritime incidents and trends, but few sea kayaking incidents were investigated by them during the years of this study and no other statutory agency or sporting body collected reports. Between Oc-

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tober 1992 and September 2005, Paul Caffyn, legendary New Zealand expeditionary sea kayaker, assembled reports into a Kiwi Association of Sea Kayakers (KASK) database about incidents where a rescue had been required. Using the information in the reports variables analysed in this study were: location, month, year, incident severity rating, numbers involved, gender, nationality, age, type of kayak, type of trip, sea state, wind direction, wind strength, medical problems, causes of death, safety gear carried, and contributory factors. The purpose of this research was to analyze the information for trends and insights into how incidents happen and their potential for serious harm. The study aims to raise kayakers' awareness and knowledge to make better safety decisions.

Methods

Data relating to 50 incidents were collected on an informal retrospective basis either as a result of an eye witness account and/or from media reports between October 1992 and September 2005. All incidents involved rescues. Sea kayakers in New Zealand, knowing of Paul Caffyn's interest in this area, forwarded information to him. Paul himself collected newspaper cuttings and personally investigated many of the incidents. Some additional information was obtained from Maritime New Zealand. Up until December 2002, 27 of 32 reports were sourced from local and/or national newspapers alone. The remaining reports included collateral information from people involved in the incidents and experienced sea kayakers who were asked to investigate the incidents; they talked with individuals such as rescuers, onlookers, and the victims themselves. From May 2004 (5 reports) marine weather forecasts and recordings from the area at the time of the incident were obtained from the New Zealand Meteorological Service. Sea kayak retailers and/or manufacturers were consulted from time to time (and in all incidents from May 2004) regarding specific technical issues. Paul Caffyn gave me his reports to analyze and publish to raise public awareness of how incidents happen and their potential for serious harm. Paul also assisted the author to clarify the variables.

The locations were recognized geographic areas around New Zealand (Figure 1). Age was recorded as a range: <17 years, 17–24 years, 25–39 years, 40–54 years, 55–64 years, and >64 years. The numbers of kayaks and kayakers in each incident were always recorded, as was gender when known. "Nil" experience level involved those kayakers with no experience. People who had kayaked only a few times were termed "novice." Participants with some prior sea kayaking experience were classified as "some experience." "Moderate"

Figure 1. Map of New Zealand. Source: www.wdc.govt.nz/resources/8038/image001.jpg. Accessed July 276, 2009.

meant the kayaker had basic rescue skills and had probably sea kayaked regularly in sheltered conditions. "Advanced" signified that the kayaker was skilled in a variety of conditions. The wind direction was headwind, offshore, onshore, tailwind, or unknown. Wind strength was based on the Beaufort Scale: "light" winds 0–10 knots, "moderate" 11–16 knots, "strong" 17–27 knots, and "gale" above 27 knots. Sea state was estimated using the World Meteorological Organization sea state code.⁴ "Calm" ranged from glassy to wavelets (0–0.5 m waves); "choppy" meant 0.5–1.25 m waves, and "rough," 1.25 m or greater waves. Types of kayaks were single sea kayak (closed cockpit), sit-on-top single, sit-on-top double, open canoe, multi-sport, double sea kayak (closed cockpit), river canoe, any other design, and design unknown.

Contributory factors identified were poor judgment, inadequate level of skills (for sea and weather conditions reported), capsizing, having no signalling device, rough sea, unsuitable kayak (for the trip), inadequate clothing (for the weather and sea temperature), strong winds, offshore wind, ignored the marine weather forecast or unsuitable prevailing conditions, river/bar sea state, no personal flotation device (PFD), collision (with powered vessel), becoming separated from the kayak, and other. Hypothermia was both a contributory factor and a type of medical problem. "Poor judgment" included any situation where it appeared from the reports that the participant(s) had made a decision that in hindsight had con-

Table 1. Location of sea kayaking incidents in New Zealand, 1992–2005

<i>North Island</i>			<i>South Island</i>		
<i>Area</i>	<i>Total no. incidents</i>	<i>Fatalities</i>	<i>Area</i>	<i>Total no. incidents</i>	<i>Fatalities</i>
Northland	4	2	Marlborough	2	0
Auckland	4	0	Tasman	2	1
Coromandel	2	1	Canterbury	8	2
Bay of Plenty	3	1	Fiordland	2	0
Lake Taupo	2	0	Nelson	3	2
Rotorua Lakes	4	0	West Coast	2	0
Hawkes Bay	1	1	Otago	2	1
Taranaki	1	1	Stewart Island	1	1
Wellington	6	1			
Cook Strait	1	0			
Totals	28	7		22	7

tributed to the outcome. This included social and psychological causes.

Medical problems reported were head injury, sprain (included all muscle strains, ligament and tendon injuries), asthma, sea sickness, hypothermia (included cold injury and/or illness), drug reaction, seizure, and abrasions (minor cuts, scrapes, blisters). Where death occurred it was caused by drowning, hypothermia, head injury, other, or unknown.

“Trip type” was commercial (involving any commercial organization—not a private trip), fishing, event or race, and other (everything else including a private recreational trip). Where safety gear was recorded as being carried or worn it was placed in the categories: PFD, cell phone, marine VHF (very high frequency) radio, other signalling device (which included flare, whistle, and dye), and other (which included paddle float, pump, and spare paddle). Only items actually mentioned in the reports were recorded.

The Incident Severity Scale was used to assess severity of each incident. This scale is used by the NZ National Incident Database; it is an internationally accepted method of assessing the severity of incidents.⁵ We know that near miss incidents have a high potential to signal conditions that could lead to serious harm and should be investigated as thoroughly as incidents that result in serious harm.⁶ The Incident Severity Scale has helped to identify near miss incidents and so target investigations to enable identification of underlying causes. Severity is rated nil to 10, where 9 or 10 denotes fatal outcome.

Three people rated each incident to provide triangulation (the author and 2 others with considerable experience in both sea kayaking and safety management in the NZ outdoors) and the average (of the 3 ratings for each incident) was used. The average correlation coefficient among the 3 ratings was calculated using the CORREL function on

Microsoft Excel. Raters also estimated the severity rating (called “potential” severity), in nonfatal incidents, that might have eventuated if everything had gone wrong for participants, ie, the “worst case scenario.”

Tables and graphs were developed using Excel software to look at trends and contributory factors.

Results

LOCATION AND MONTH

There were 50 incidents, spread throughout New Zealand that were identified and investigated. Referring to Table 1, 28 incidents (including 7 fatalities) occurred in the North Island and 22 (including 7 fatalities) in the South Island. Only 4 were reported from the Auckland area, where at least a third of New Zealand’s total population of 4.2 million live. The largest clusters occurred in the Tasman/Nelson/Marlborough Sounds regions ($n = 7$), Wellington ($n = 6$), and Canterbury ($n = 8$). Incidents were spread throughout the year but with a third more than in any other month (8 incidents) in September (Figure 2). There were 2 incidents in September that involved 13 kayakers in each. One was an ocean race near Christchurch involving people aged 25 to 39 years and the other was a group of children in their early teens participating in an outdoor adventure experience on Lake Rotorua. The gender of the kayakers in these incidents was not recorded.

All of the September incidents resulted in hypothermia in some or all of the kayakers; 46 people in total were involved.

SEVERITY OF INCIDENTS

There was very close agreement for “actual” severity rating of incidents among the 3 raters; the correlation

Figure 2. Month of sea kayaking incidents around New Zealand, 1992–2005.

coefficient was 0.90. The correlation was lower for potential severity; the correlation coefficient was 0.56. Referring to Figure 3, most incidents had the potential for a more severe or fatal outcome and thus were significant near misses. The overall severity of incidents increased over time. Whilst most incidents involved capsizing, the lowest severity rating occurred when there was no capsize (Figure 4). Severity rating was higher when no PFD was worn, a collision occurred with a power boat, or the

victim(s) became separated from their kayak(s). The highest severity rating occurred when a kayak was hit by a powered vessel.

TYPE OF TRIP

As shown in Table 2, incidents were commercial (n = 7), fishing (n = 6), races (n = 3), or private recreational trips (n = 34). The fishing incidents all dated from 2001, with

Figure 3. Actual and potential severity rating of sea kayaking incidents in New Zealand, 1992–2005.

Figure 4. Severity rating and various outcomes of sea kayaking incidents in New Zealand, 1992–2005.

4 being in the last 18 months of the study, 4 with 1 or more fatality and experience level, where known, novice ($n = 1$) or some experience ($n = 3$). The severity rating for fishing trips was higher than for the other types of trip. Twenty-two (44%) incidents involved solo kayakers and 28 (56%) involved groups. Forty incidents (80%) involved New Zealand residents, while 10 (20%) involved overseas tourists. Where foreigners were involved there was an even distribution between North and South Island with 2 occurring in the Nelson/Marlborough Sounds area of South Island. The nationalities were German ($n = 2$), USA ($n = 1$), Israeli ($n = 2$), British ($n = 1$), French ($n = 2$), Japanese ($n = 2$), Iraqi ($n = 1$), and New Zealander living overseas ($n = 1$).

AGE, GENDER, AND EXPERIENCE LEVEL

In 5 incidents where gender was not reported there were multiple kayaks and kayakers involved (between 13 and 20 in each). Of the remaining 45 incidents, 23 were solo, and the rest involved between 2 and 4 kayakers. Where gender was known, there were 82 males (85% of total)

involved, compared with 14 females (15%) and more incidents (36 or 72%) involved males either solo or in a group. Five incidents (10%) involved females only, either solo or as a group, and 8 (16%) involved a mixed group. Women kayaking alone or in a group had a lower severity rating than men alone, while the lowest severity involved mixed groups. Males in all age groups were reported, with age between 25 and 39 years being the most common (Figure 5). Women were represented across age groups 17 to 54 years and only 1 woman was involved in the last 2 years of the study period. There was 1 incident in the 55- to 64-year age group and it was a fatality. Across the other age groups, although not tested for statistical significance, there appeared to be no clear relationship between age and severity (Table 3). Novices were more likely to be involved, while those with moderate and advanced experience were least common (Figure 6). The severity was greatest when kayakers had no experience, while having some experience had a higher severity rating than novice and moderate experience. Severity was lowest for advanced kayakers (Table 4).

Table 2. Trip type and severity rating of sea kayaking incidents in New Zealand, 1992–2005

Trip type	No. of incidents	Severity rating
Commercial	7	6
Event or race	3	5
Other including private recreational	34	6
Fishing	6	7

ENVIRONMENTAL CONDITIONS

We usually did not know if participants had checked the weather forecast before venturing out or, if they had, whether they had understood the forecast or taken heed of it. Thirty-one incidents occurred in rough, choppy, or surf conditions, but in only four of these were participants known to have advanced skills. In 10 incidents the sea conditions were unknown and in 14 the experience level was unknown. The severity was higher in calm

Figure 5. Ages and gender of people involved in sea kayaking incidents around New Zealand, 1992–2005.

conditions (Table 5). Offshore wind conditions (14 incidents) were most common where the wind direction was known (15 incidents). Strong winds frequently occurred (14 incidents) when the wind strength was known (29 incidents) Severity was higher in light winds (Table 6).

MEDICAL PROBLEMS

Medical problems reported are summarized in Figure 7. Hypothermia was the most common (16 cases) and then sprains (6 cases). In 3 individuals, sprains were related to rescue procedures in stormy conditions (2 shoulders, 1 knee). Two kayakers sustained sprains (shoulder and foot) in 1 incident when a power boat collided with a double kayak. One woman sprained a hip when she attempted to jump out of her kayak in surf. The head injury (and subsequent death) resulted from a collision between a sea kayak and powered vessel. The case of sea sickness occurred when 2 men were crossing Cook Strait, a 30 km+ stretch of open water separating North and South Island notorious for its rough conditions. One of the men required a helicopter rescue after developing incapacitating side effects to medication used to treat sea sickness. Asthma occurred in 1 incident, triggered when the victim capsized into cold water in stormy conditions. One death was considered to be the result of a seizure in a kayaker who had recently had surgery for a brain

tumor. “Other” refers to a “damaged nose” suffered by a kayaker after being swept out to sea from a river on the west coast of South Island. There were 14 fatalities caused by: head injury ($n = 1$), seizure ($n = 1$), drowning ($n = 9$), and unknown ($n = 3$). One drowning victim was known to have been suffering from hypothermia prior to death.

SAFETY DEVICES

Safety devices were infrequently reported. Most often reported was a PFD. Participants in 41 incidents (82%) were wearing a PFD; in 7 incidents (14%) a PFD was not worn and in 2 (4%) we did not know. Not wearing a PFD was associated with a higher incident severity rating. The severity rating where a PFD was worn was 5, but when not worn it was 7. Eight of the 14 fatalities were known to be wearing a PFD, while 4 were reportedly not wearing a PFD; PFD status was unknown for the remaining 2 fatalities. Other safety devices were carried in 12 (24%)

Table 3. Age of participants and average severity rating of sea kayaking incidents in New Zealand, 1992–2005

Age (y)	No. of participants	Average severity rating
Under 17	10	5.9
17–24	8	5.9
25–39	30	5.8
40–54	9	5.8
55–64	1	9.0
Unknown	10	4.4

Figure 6. Experience level of people involved in sea kayaking incidents around New Zealand, 1992–2005.

Table 4. Experience level and severity rating of sea kayaking incidents in New Zealand, 1992–2005

<i>Experience level</i>	<i>No. of incidents</i>	<i>Severity rating</i>
Nil	4	7.3
Novice	15	5.2
Some experience	9	6.0
Moderate	4	5.0
Advanced	4	4.3
Unknown	14	5.9

incidents and there was 1 fatality in this group. Of these 12 incidents, cell phones were reported in 6 and a VHF (very high frequency) marine radio in 1. On 1 occasion a cell phone was used by a solo multi-sport kayaker to summon a helicopter rescue after he capsized off the Otago coast; he would have died otherwise. The VHF marine radio (plus dye) was used in the Cook Strait incident. When safety devices were not carried (5 incidents) there were 3 fatalities.

CONTRIBUTORY FACTORS

Poor judgment and inadequate skills were the most frequent contributory factors and, with lack of signaling devices and capsizing, occurred in more than 50% of incidents (Figure 8). Where there were strong offshore winds and rough seas, the kayakers in these incidents chose to go out in adverse conditions; thus it could have been that poor judgment and/or poor decision making were the most important contributory factors. Using the wrong kayak for the conditions, for instance using a river kayak without watertight bulkheads or a small unstable sit-on-top-kayak for offshore ocean trips, contributed to several incidents. Contributory factors in fatal incidents were very similar, although poor judgment, inadequate skills, capsizing, and no signaling equipment were featured more commonly (Figure 9).

Table 5. Sea state and severity rating of sea kayaking incidents in New Zealand, 1992–2005

<i>Sea state</i>	<i>No. of incidents</i>	<i>Severity rating</i>
Calm	9	7
Choppy	9	5
Rough	14	5
Surf	6	6
Unknown	10	6

Table 6. Wind strength and severity rating of sea kayaking incidents in New Zealand, 1992–2005

<i>Wind strength</i>	<i>No. of incidents</i>	<i>Severity rating</i>
Unknown	21	6
Gale	6	5
Strong	14	4
Light	8	7
Moderate	1	5

Discussion

This retrospective epidemiologic analysis examined the location, month, severity, trip type, age, gender, and experience level of participants, environmental conditions, medical problems reported, and factors contributing to 50 sea kayaking incidents in New Zealand between 1992 and 2005.

The study was limited because it was retrospective, unlikely to capture all incidents, and based on a relatively small number of incidents. Also there were no data on denominator participation to compare numbers with the actual numbers of people who were sea kayaking in each of the groups over the period of the study. Many reports, especially prior to December 2002, relied almost entirely on newspaper accounts, so there was significant likelihood of reporting bias and inaccuracies in the data. There was often much missing information making it difficult at times to piece together the sequence of events in the incidents.

LOCATION, MONTH, AND ENVIRONMENTAL CONDITIONS

Incidents were not always clustered in areas of highest population density. One possible explanation for this is the different environmental and sea conditions. For instance, in the Auckland area, which is generally sheltered by islands in the Hauraki Gulf, the wave energy is dispersed and sea conditions are more benign. Maybe incidents were simply not reported in Auckland or people were less likely to sea kayak there. Where there are gaps within mountain ranges, such as in Wellington and Marlborough Sounds, the wind becomes accelerated and unpredictable. Steep beaches and river bar conditions prevail in Canterbury and the West Coast. In the South Island, especially in the Tasman area, there are some strong tidal streams. A higher number of incidents in Tasman/Nelson/Marlborough probably occurred because this is a very popular kayaking destination.

Strong offshore winds and/or choppy, rough seas would have logically increased the likelihood of an in-

Figure 7. Medical problems reported by people involved in sea kayaking incidents in New Zealand, 1992–2005.

cident. In 6 of the 8 incidents in September, the weather, sea conditions, and hypothermia were major contributing factors. One of these was a race near Christchurch in stormy conditions with 14 people rescued. Another was a large group of children participating in an outdoor adventure program who all capsized on Lake Rotorua in atrocious conditions and most suffered hypothermia. The forecast and conditions had not been adequately checked during that trip, and a decision was mistakenly made to venture out. People may have failed to realize that the sea temperature in September was nearly as cold as in mid winter, because the air temperature was starting to increase after winter.^{7,8} Maybe some participants had just resumed kayaking after the winter break and were less well prepared for the conditions as a result. The often unsettled climatic conditions in September (equinox) may have been underestimated, although decisions about kayaking are not often based on the monthly “mean.” A higher severity rating in calm conditions with light winds

(when known) suggested that the conditions alone may not have been the most important factor.

SEVERITY OF INCIDENTS

This study reaffirmed the relationship between near misses, serious incidents, and fatalities. The different “potential” severity ratings for the 3 raters showed that their perceptions were different. This would logically have been expected as rater’s perceptions of what might have happened would not have been uniform. There was no right and wrong answer, just different perceptions of how bad it could have potentially been; this was a valid finding in itself.

As more people were kayaking there were more incidents, but this did not explain the increasing severity. Possibly only the most newsworthy (and therefore more severe) incidents were reported. There were 5 deaths in the 6 fishing incidents, which all occurred towards the

Figure 8. Contributory factors in sea kayaking incidents in New Zealand, 1992–2005.

Figure 9. Contributory factors in fatal sea kayaking incidents in New Zealand, 1992–2005.

end of the study period and influenced the severity trend. One may have expected with our increasing knowledge of safety management, availability of skills training, and better quality equipment that the severity would have decreased. However, people may have taken greater risks because they were carrying a safety gadget (like a cell phone). The “risk homeostasis” theory suggests that people adjust the amount of risk they are prepared to take upwards if a new safety device comes out.⁶ Carrying a cell phone might have made a kayaker feel more comfortable, but it would not have increased safety. The solo multi-sport kayaker rescued in Otago was paddling alone in rough conditions; he may have increased his risk because he was carrying a cell phone.

Remaining with the kayak probably resulted in a lower severity because a kayak is a large, visible, and supportive flotation device that is more easily spotted by rescuers than a lone swimmer with or without a PFD. Using the kayak to stay at least partly out of the water may have delayed hypothermia. The kayakers may have let go of their kayaks as they became hypothermic, so that a more severe outcome would have been inevitable.

TYPE OF TRIP

Fishing incident results suggested an increased risk for this group. There may have been a relationship between sit-on-top kayaks and fishing incidents (3 of 6, but the type of kayak was unknown in 2). The increase in fishing-related incidents towards the end of the study period probably reflected its rising popularity. One of New Zealand’s largest kayak manufacturers and another national retailer have said that during the period of the study up to 68% of kayak sales were recreational sit-in or sit-on-tops and the rest a combination of closed cockpit sea, racing, or white-water kayaks (written communica-

tion from Max Grant, Quality Kayaks, NZ, and verbal communication from Steve Knowles, Canoe and Kayak, Mount Maunganui, NZ, August 2009). From 2000 the recreational boats became mostly sit-on-tops; by 2005 more than 50% were bought to use for fishing at least some of the time and 10% of the total number of kayaks sold were specifically designed sit-on-top fishing kayaks.

AGE, GENDER, AND EXPERIENCE LEVEL

The findings regarding gender and age were similar to research into other outdoor activities in New Zealand,⁶ Australia,⁹ and the United States.¹⁰ However, it was unclear whether there was a true increased risk for males because we did not know the actual number of men and women who sea kayaked over this period; the results may have simply told us that most people who sea kayaked were male. Similarly we did not know the number of men who sea kayaked in any of the age groups so that the results may have told us only that most people who sea kayaked were males aged 17 to 39 years old. The higher severity and numbers of males were similar to findings in other outdoor incidents worldwide, suggesting there may have been behavioral issues specific to this group and/or that this group was most likely to be involved in outdoor recreation activities.^{11,12} The 1 fatality in the oldest age group was an inexperienced German tourist, who despite advice to the contrary from local people, decided to kayak around Stewart Island (an exposed and very rough passage) in a totally unsuitable kayak with no bulkheads, no signaling equipment, and his belongings in plastic bags. He was never seen again and was presumed drowned.

As most people do not kayak alone, most incidents involved groups of kayakers. We could not assess the relative risk for overseas tourists as we had no access to

information regarding total numbers of tourists and New Zealanders kayaking during this time period.

The sea can be a serious and unforgiving environment where conditions can change rapidly. Skills are required to stay upright in a kayak and perform a self rescue after capsizing; it takes a long time to master these skills. Novices and the inexperienced may have been commonly involved because they were not equipped to deal with the demands of the conditions, were ignorant of this fact, and lacked the skills or knowledge to use the boat safely. It may also have been because there were more novice kayakers on the water over the period of the study. Experienced kayakers, however, still had incidents. Researchers have found that experienced people put themselves into more challenging conditions and consequently there is less room for error so that when things go wrong there can be a more serious outcome.⁶ Because experience level was often a judgment call on the part of the investigator it was subjective and open to bias; we need to develop a tool for measuring experience level.

MEDICAL PROBLEMS

It was likely that only “newsworthy” medical problems were reported; data relating to most minor injuries and illnesses were probably missing. This study found some similar injury trends to white-water kayaking research, which reported the upper extremity most frequently involved and sprains and tendonitis represented about 30% of the injuries.^{2,3} The “sprains” in this study all required hospital treatment, but there was not enough information to comment about their severity. The shoulder injuries usually occurred during rescue procedures and not, as in white-water kayaking, when performing high-brace maneuvers. The incident involving sea sickness reminds us not only that this ailment is a disabling problem that may result in the victim being unable to continue paddling, but also that we should be careful about the use of unfamiliar medications that have the potential to cause unpleasant and even life-threatening side effects. The case of asthma is a warning to asthmatics to ensure their disease is well controlled, to always carry their asthma inhalers, and to make sure that their fellow kayakers are aware of their condition and able to help them use their inhaler in an emergency such as a capsize and cold water immersion.

Hypothermia often occurred because many incidents involved capsizing and immersion in cold water. In the author’s experience hypothermia is poorly understood in New Zealand and under-rated by sea kayakers as a cause of serious injury and fatalities; sea kayakers are often ill-prepared for cold water immersion. Once immersed,

unless a rescue is achieved promptly, even in New Zealand, a victim quickly becomes tired and cold and loses the energy and manual dexterity required to successfully re-enter the kayak.¹³ Hypothermia was then logically often seen in incidents with a higher severity rating.

CONTRIBUTORY FACTORS

There were a number of factors identified as contributing to each incident. Most incidents appeared to have behavioral or human rather than physical causes. These findings were supported by international research.^{6,14} Being inexperienced with inadequate skills inevitably resulted in poor decision making, which highlighted the need for sea kayakers to seek training.

Carrying a means of signaling, especially after capsizing, may have expedited rescues and thus reduced the fatal outcomes. The American Canoe Association found that a substantial proportion of fatalities occurred when PFDs were not worn.¹ Wearing a PFD would have helped to prevent hypothermia, aided flotation, and increased visibility of the victim after capsizing and thus logically would have reduced incident severity. An association with fatalities was not proven. Capsizing was common because many people were unskilled and kayaking in rough, windy conditions. Nevertheless, the possibility of capsizing is a part of kayaking that often adds challenge to the experience, while not necessarily representing a significant risk if the kayaker is able to roll or perform a re-entry. Both wearing inadequate clothing and hypothermia could logically have been related. Wearing clothing designed to protect the wearer from the effects of wind, cold, and wet, even when immersed in water, helps prevent hypothermia. Incidents involving river/bar conditions occurred where kayakers became caught in currents and surf. These areas should be avoided or used only at “slack tide” by even the most experienced.

Only 3 incidents were arguably beyond the control of the sea kayakers; these were the collisions with powered vessels and, not unexpectedly resulted in death and/or serious injury. One of these involved a jet ski close to shore exceeding the speed limit for the area and colliding with a kayak, killing 1 of the occupants. The other 2 were power boats where the helmsmen failed to see the kayak, 1 helmsman blaming “sun strike.” However, there is never a single cause to an incident. Poor visibility of the kayak as well as inattentiveness by the helmsman of the powered vessels may have both been contributory factors in these incidents.

Conclusion

Fifty sea kayaking incidents in New Zealand between October 1992 and September 2005 were studied retrospectively. The incidents were all complex events involving a multitude of people, equipment, and environmental factors interacting in different ways over time. Human factors were more likely to contribute to incidents than physical events. Males age 17 to 39 years had more incidents, often in rough, windy, offshore conditions. Hypothermia and sprains were the most commonly reported medical problems. The severity of incidents increased over time. Fishing trips and incidents in calm conditions and light winds had more severe outcomes. Collisions with powered vessels were often fatal. Of particular interest is the finding that staying with the kayak after capsizing and the wearing of a PFD may have reduced the severity of an incident. Although based on small numbers and unlikely to capture all incidents, this research raised many questions and highlighted the need to analyze incidents in depth to begin to identify where intervention may reduce loss or damage to persons involved and their equipment.

Acknowledgment

The author would like to acknowledge the invaluable contribution from Paul Caffyn who has dedicated considerable time over many years to collecting incident reports. Some funding support was provided by Water Safety New Zealand and the Kiwi Association of Sea Kayakers. Dr Jenny Visser, Cathye Haddock, Paul Chaplow, John Kirk Anderson, Catherine Hutchins, and Chris Matson kindly assisted with peer reviewing, proofreading, and presentation. There is no conflict of interest with this study.

References

1. Snow-Jones A, Black G, Dillon PS, Jenkins D. *Critical Judgement II. Understanding and Preventing Canoe and Kayak Fatalities. 1996–2002*. Springfield: American Canoe Association; 2004.
2. Fiore DC, Houston JD. Injuries in white-water kayaking. *Br J Sports Med*. 2001;35:235–241.
3. Fiore DC. Injuries associated with white water rafting and kayaking. *Wilderness Environ Med*. 2003;14:255–260.
4. Meteorological Organisation sea state code. Available at: http://en.wikipedia.org/wiki/Sea_state#World_Meteorological_Organization_sea_state_code. Accessed August 13, 2007.
5. Davidson G. Incident severity scale. 2005. Adapted and expanded from the Accident Frequency Severity Chart (Priest, 1995). Available at: <http://www.incidentreport.org.nz/> Accessed October 8, 2007.
6. Haddock C. *Outdoor Safety. Risk Management for Outdoor Leaders*. Wellington, NZ: NZ Mountain Safety Council; 2003.
7. Wave buoys water temperature April 2007–April 2008. Environment Bay of Plenty. Available at: <http://www.envbop.govt.nz/MonitoredSites/cgi-bin/hydwebserver.cgi/points/details?point=834&trType=1&trParam=0>. Accessed April 9, 2008.
8. Greig MJ, Ridgeway NM, Shakespeare BS. Sea surface temperature variations at coastal sites around New Zealand. *NZ J Marine Freshwater Res*. 1988;22:391–400.
9. Brookes A. Outdoor education fatalities in Australia 1960–2002. Part 3. *Aust J Outdoor Educ*. 2004;8:44–56.
10. Drowning fact sheet 2006. Water Safety New Zealand. Available at <http://www.watersafety.org.nz/pdfs/drowning/2006%20Drowning%20Facts.pdf>. Accessed December 9, 2007.
11. Motor vehicle crashes in New Zealand. Ministry of Transport, NZ Government. Available at: <http://www.transport.govt.nz/motor-vehicle-crashes-in-new-zealand-index/>. Accessed December 9, 2007.
12. White A, Homes M. Patterns of mortality across 44 countries among men and women aged 15–44 years. *J Mens Health Gender*. 2006;3:139–151.
13. Kiwi Association of Sea Kayakers. *The KASK Handbook—A Manual for Sea Kayaking in New Zealand*. 4th ed. Runanga: P. Caffyn; 2006.
14. Bird FE Jr, Germain GL. *Practical Loss Control Leadership*. The Conservation of People, Property, Process and Profits. Institute Publishing, Loganville, Georgia; 1992.