



CRITICAL JUDGMENT II

Understanding and Preventing Canoe and Kayak Fatalities
1996-2002



Acknowledgements

Co-Authors

Dr. Alison Snow-Jones, PhD, Assistant Professor, Wake Forest School of Medicine
Gordon Black, ACA Safety Education and Instruction
Pamela S. Dillon, ACA Executive Director
David Jenkins, ACA Conservation and Public Policy

Contributors

Virgil Chambers, National Safe Boating Council
Dr. Gary Green, PhD, Research Project Manager, USDA Forest Service
Jonathan D. Nylen, Graphic Designer and Layout
Cheri L. Nylen, ACA Safety Education and Instruction Program Manager
Bruce Schmidt, US Coast Guard Office of Boating Safety Statistician
Dr. Alison Chapman
Brandan Hardie, ACA Communications Manager

Photo Credits

Wiley Wales
Avant Marketing, Charlie Wilson
Dagger, Inc.
ACA Stock Photos
Tammy Kelly

This project made possible through support provided by the
National Safe Boating Council



Charles E. Wilson, ACA President
Pamela S. Dillon, Executive Director, ACA

ACA Board of Directors 2004

Mike Aronoff	Kirk Havens	Paul Sanford
Connie Blackwood	Jerold Kappel	Nita Settina
Darren Bush	Robert Kauffman	Ed Sharp
Patti Carothers	Jeff Liebel	Christopher Stec
Jeff Dionne-Dickson	Elaine Mravetz	Greg Wolfe
Sam Fowlkes	Joe Pulliam	Peter Zern

Liaison Board Members

Ed Councill, Professional Paddlesports Association
Matt Menashes, Professional Paddlesports Association
John Malatak, United States Coast Guard
David Mason, USA Canoe/Kayak; Councilor's Roundtable

TABLE OF CONTENTS

Acknowledgements	2	III. U.S. Canoe and Kayak Fatality Analysis 1996-2002	16
About the American Canoe Association	4	Introduction	
Foreword:		Overview	
By the National Safe Boating Council	5	Accident Types	
I. Introduction	6	Accident Causes and Risk Factors	
<i>Sidebar: Adventure & Managing Risk</i>	7	-Occupant Movement / Weight Shift	
<i>Sidebar: The Paddle's Many Paths</i>	8	-PFD Use	
II. Canoeing & Kayaking: An Overview	9	-Water and Weather Conditions	
The Experience		-Operator Experience	
Participation-		-Alcohol Use	
-Who Paddles and Why		-Man-made Hazards	
-The Numbers		-Other Vessels	
-Future Trends		Accident Victims	
Unique Hazards		Human Error and Canoe Accidents	
-Watercraft Size and Stability		Conclusions	
-Perception of Skill Required		- A Note About Risk	
-Impact of Weather Conditions		IV. ACA Strategy to Reduce Canoe and Kayak Fatalities	28
-Low-Head Dams		-Reaching Accident Prone Populations	
-Strainers (Sweepers)		-Crafting Effective Messages	
-Whitewater and Surf Zone		-Expanded Delivery of Instruction	
-Remoteness		-Public Policy	
Managing the Risks		Recommendations	
-Basic Safety Knowledge		V. References	33
-Proper Gear and Clothing		ACA Programs & Resources	
-Paddling Skills		Glossary	
-Rescue			

American Canoe Association, Inc
7432 Alban Station Blvd Suite B 232
Springfield VA 22150
www.acanet.org
1-703-451-0141

About the ACA

Mission: The American Canoe Association (ACA) is a national nonprofit membership organization dedicated to promoting canoeing, kayaking and rafting as safe and enjoyable lifetime recreation, while working to protect and preserve the waterways on which those activities depend.

History: Founded in 1880 by a small group of avid outdoorsmen in the State of New York, today ACA is the nation's oldest and largest nonprofit organization serving the paddlesport community. ACA also holds the distinction of being the oldest recreation-based waterway conservation organization in America and ranks among the country's oldest sporting organizations.

Membership: ACA currently has more than 50,000 individual members enrolled in a variety of membership categories, with an additional 50,000 individuals affiliated through a nationwide network of local ACA-affiliated paddling clubs.

Program Areas: The primary mission-based programs and services provided by ACA include: safety education and instruction; waterway stewardship and access; athletic competition, recreation and public education.

Safety Education & Instruction Activities: Historically, ACA has been at the forefront of promoting boating safety, providing safety education and maintaining a nationally recognized program of paddlesport instruction and certification. Working in concert with the U.S. Coast Guard, American Red Cross, National Safe Boating Council and others, ACA provides a comprehensive range of programs, publications and other materials toward this end. ACA currently certifies approximately 4,000 ACA Instructors in various types of canoeing, kayaking and rafting. Each year ACA Instructors deliver the ACA program to an estimated 100,000 individuals participating at the student level.

Waterway Stewardship Activities: ACA is dedicated to the preservation and protection of America's natural areas, focusing primarily on rivers, streams, lakes, coastal waterways and their surrounding environments. ACA is active in a wide variety of efforts from promoting stewardship to advocacy on issues important to paddlers. ACA weighs in on resource management plans, public land funding and policy issues, water quality standards, pollution limits, user conflicts, and recreation related fee and access issues.

Paddlesport Recreation: ACA sanctions more than 700 paddlesport events annually. ACA's Programs and Special Events department recruits and services corporate sponsors associated with such events. ACA events range from instructional clinics and other small local events to many of the largest, most visible event properties in paddlesport.

Publishing Activities: Working both independently and through its subsidiary, Paddlesport Publishing, Inc., ACA publishes a wide range of periodicals, books, videos and other paddlesport-related media. Its lead publication, bimonthly *Paddler* magazine, is published through PPI and currently has an estimated readership of 225,000 readers per issue. A full-color publication, *Paddler* is provided as a benefit to ACA members and is also sold on newsstands and to individual subscribers. PPI also publishes a quarterly trade magazine (*Paddle Dealer*) and the bi-annual whitewater magazine *Kayak*. In addition to the publications produced through PPI, ACA publishes 18 book titles, 9 videos, and a host of other informational and educational literature.



Foreword From the National Safe Boating Council

The National Safe Boating Council has a vital interest in the content of this examination of canoe and kayak accidents by the American Canoe Association. This report addresses the known risks in this popular and growing form of recreational boating, and provides important recommendations for prevention measures. All can benefit from heeding the important, over-arching message derived from this report; **in most cases fatal paddlesports accidents are preventable.**

Any paddler can capsize. The novice paddler, especially, should consider capsize part of the sport. As you review the information in this document, you will see that what overall paddler preparation and response to a mishap were keys factors that determined the final outcome. Paddler behavior such as wearing a properly fitted life jacket (personal flotation device), dressing suitably for the experience (critical when boating on cold water), avoiding alcohol, and selecting a waterway commensurate with ones' experience, could prove to be the difference between just getting wet or never going home. What is intended to be an enjoyable activity can turn tragic if wrong choices are made.

Canoeing and kayaking are enjoyable forms of recreation that should be promoted to all. The newest paddlers need access to information on intrinsic risks and how to be safe. These risks can be calculated, diminished, avoided, or managed through awareness, education, and training. Reading through the report, these conclusions are clear.

Thanks to the American Canoe Association for analyzing and presenting this important look at paddlesport accident statistics. The ACA, from their position as the leader in paddlesports, has relayed important findings to the national recreational boating safety community on this growing segment of recreation.

Virgil Chambers
Executive Director
National Safe Boating Council



The National Safe Boating Council is a national non-profit 501c3 advocacy membership organization that provides a forum for advancing and fostering safe and enjoyable recreational boating. The NSBC promotes the need for research initiatives that support boating education and safety awareness. The American Canoe Association is a long-time organizational member of the NSBC, and the organizations share a common goal of boating safety education and outreach.

Introduction

Canoeing and kayaking continue to be among the fastest growing recreational activities in the United States. Kayaking is growing faster than any other outdoor activity on land or water. As a result of their popularity, canoeing and kayaking represent an ever-larger proportion of boating activity on the nation's waterways. This growth trend resulted in a regrettable number of canoeing- and kayaking-related fatalities as explored in the first edition of *Critical Judgment: Understanding and Preventing Canoe and Kayak Fatalities*. This trend will be further explored in this second edition.

To understand and address canoeing and kayaking fatalities, one must first understand the wide variety of specific activities that are included under the broader category of "canoeing and kayaking." This category includes pursuits such as extended wilderness expeditions, challenging descents of whitewater rivers and multi-day trips on the open ocean. These adventurous activities have more in common with backpacking and mountain climbing than with most other forms of boating. Also included in "canoeing and kayaking" are seemingly milder activities, such as a casual paddle on a lake, a float down a gently flowing river, or a fishing trip. These milder activities have broad appeal, and are participated in by a very large portion of the population.

Since its inception, the American Canoe Association (ACA) has been working to improve paddlesport safety. It has done so by helping train and certify canoeing and kayaking instructors, and by disseminating safety messages and information to ACA members and other paddlers who are within the organization's reach. This dedicated effort has helped produce a safety ethic among experienced paddlers that

is well beyond that of most boaters. Most canoeing and kayaking enthusiasts wear personal flotation devices (PFDs), travel with other experienced paddlers, dress properly for conditions, and have taken courses in paddling technique, safety and rescue.

Concerned with the fatality numbers attributed to canoeing and kayaking, ACA continues its review of canoeing and kayaking fatalities reported to the United States Coast Guard (USCG). Accident descriptions suggest that a large portion of canoeing and kayaking fatalities involve people who have little or no experience

with canoes or kayaks, who lack fundamental paddling skills, and who have not been effectively reached with safety messages. Many of those who die while using a canoe or a kayak probably do not even consider themselves a "canoeist" or a "kayaker" and therefore do not seek

out paddling-specific safety information.

In order to address more effectively the safety needs of all people who take a canoe or kayak onto the water, and to better reach those at highest risk, the ACA conducted further research into the specific details of and contributing factors associated with canoeing and kayaking fatalities. This report documents the findings, provides relevant information on the nature of paddlesport, and makes recommendations on how to reduce canoe and kayak related fatalities.

In this report, the ACA also provides important information about the nature of canoeing and kayaking and about the recreational goals of those participating. Because of paddlesport's steady growth over the past decade, it is important that lawmakers and boating regulators develop an understanding of this diverse sport. Understanding the unique nature



Provided courtesy of Tammy Kelly

Introduction

of canoeing and kayaking, and the objectives of those who participate, will help these officials to more effectively address paddlesports-related issues and to recognize when certain rules and regulations governing other boats—such as motorized craft—simply are not relevant to small human-propelled boats. Most importantly, by understanding the unique challenges associated with paddlesports, these officials can help improve paddler safety.

Critical Judgment II represents the next chapter in ACA's ongoing effort to reduce the number of fatalities that occur while canoeing and kayaking. It provides an informational foundation that will help individuals concerned with canoe and kayak safety to develop programs and messages that can effectively reach those who are most at risk.



C. E. Wilson; Avant Communication

Adventure & Managing Risk

While adventure and exploration are steeped in the nation's history, in recent years the popularity of adventurous outdoor activities has grown like never before. The variety of adventurous activities available to the public is equally unparalleled. Common tickets to adventure include mountain biking, rock climbing, backcountry skiing, scuba diving, backpacking, mountaineering, surfing, ice climbing, skydiving, wilderness canoeing, ocean kayak touring, and whitewater kayaking.

These activities, while diverse, all share the allure of adventure and its many benefits. Outdoor adventure teaches self-reliance and personal responsibility, it causes participants to challenge themselves physically and mentally, and rewards the effort with a unique personal satisfaction. For those who are not enticed by these adventurous activities, the pursuit of them may seem too risky - or even crazy. That view is typically an uninformed one, lacking any knowledge or understanding of the training and skill level of those engaging in such activities.

Adventure is largely about managing risk. The keys to managing any risk are knowledge and skill. A whitewater paddler skilled at running the most challenging rapids and waterfalls has spent countless hours in practice, recognizes hazards, has prepared for possible mishaps, and is in an environment he or she knows and understands. An inexperienced and unskilled person who takes a canoe out on a placid lake or a gentle river is arguably at higher risk than the experienced and skilled adventurer. The absence of skill, experience and sound judgment creates a greater likelihood of errors, while at the same time leaving absolutely no margin for errors.

While casual paddlers do not require the same level of skill and knowledge as the most adventurous, they should emulate the adventurers approach to managing risk. Developing paddling skills, understanding the environment one is in, and taking safety precautions (such as wearing a PFD) are the practices of the most capable athletes, failing to do so are the practice of the foolhardy.

The Paddle's Many Paths

There are many types of canoeing and kayaking. This diversity is present in vessel type, paddling technique, and in the waters that are traveled. Here is a list of the most common varieties:

Flatwater Canoeing – This is canoeing on a lake, reservoir, slow flowing river, or other relatively calm body of water. Falling within this category is everything from taking out a rental canoe out on a lake for a few hours, to going on a multi-day canoe journey down a gentle river.

Recreational Kayaking – Like flatwater canoeing, this type of kayaking occurs on flat or slow moving water. It is characterized primarily by the use of slow and stable recreational kayaks. These kayaks are fairly inexpensive, wide, and usually have a flat-bottomed hull. This is the fastest growing segment of the kayak market. Some consider recreational kayaking to be an entry level of kayak touring.

Kayak Touring – This category of kayaking, sometimes referred to as *sea kayaking*, includes such diverse activities as day kayaking on a small lake, multi-day kayak excursions, and kayaking on the open ocean. Touring kayaks are typically long, sleek, have storage compartments, and are designed for speed and efficiency. These kayaks are often used for long expeditions and are very sea worthy.

Whitewater Canoeing – Is canoeing on rivers and streams with fast current and rapids. It occurs on everything from mild, bouncy class I and II rivers, to raging class IV and V rivers. All types of canoes are used on very mild whitewater, but paddling more difficult whitewater requires the use of canoes specifically designed for whitewater use. Whitewater canoes are designed with more rocker for quick turning and accommodate the use of floatation bags to keep water out and improve buoyancy. Some whitewater canoes are decked and resemble whitewater kayaks.

Whitewater Kayaking – Is kayaking on rivers and streams with fast current and rapids.

Whitewater kayaks are less than 12 feet in length, typically made of plastic, and can take paddlers into the deepest, wildest gorges, through powerful rapids, over waterfalls as high as 80 feet, and down raging flood-swollen rivers. Whitewater kayakers are always on the cutting edge of navigation. Over the past 20 years technical advances in the design of whitewater kayaks has turned once unrunnable chasms into popular play spots.

Squirt Boating – The main objective of squirt boating is, as odd as it seems, not to play in the surface waves of whitewater, but to play in the underwater currents created by rapids. Squirt boats are low volume kayaks, typically made of fiberglass or Kevlar, that function best just below the water's surface.

Wilderness Tripping – Is the taking of extended canoe or kayak journeys deep into wild, uninhabited landscapes. These journeys are typically longer than a week and require the use of large canoes or kayaks that have a lot of storage space.

Surf Kayaking – This activity utilizes short kayaks, similar to those used on whitewater, to surf ocean waves. Surf kayakers try to catch and surf waves the same as traditional surfers do, the main differences are that the kayakers are sitting down and use a paddle for steering.

Outrigger Canoeing – Very popular in Hawaii, this traditional south pacific type of canoeing utilizes a canoe with an outrigger. The outrigger canoe is very stable and used for general recreation and competition on the open ocean.

Canoe Sailing – Just like it sounds, this is the sailing of canoes that have been outfitted with a sail. The sport of canoe sailing dates back at least to the 1800s.

Poling – In most river canoeing the objective is to travel downstream, the objective in poling is to travel upstream utilizing a canoe and a long pole.

Canoeing and Kayaking: An Overview

The Experience

The joys and benefits of paddling a canoe or kayak are many and the reasons people are drawn to paddling are equally varied. Each year thousands of people contact ACA expressing a desire to take up canoeing or kayaking. Many of those people share with ACA staff the reasons they want to pursue these activities. Some want to escape the noise and stress of everyday life by exploring the rivers or lakes near their home; others seek a means to venture into the wilderness; exercise is an objective for many paddlers, as is observing wildlife, playing in whitewater, plunging down steep creeks and over waterfalls, and navigating the open ocean. There are also those who use a canoe or a kayak in activities such as photography, fishing, or social outings.

Canoeing and kayaking enthusiasts do not typically view themselves as part of the broader boating community. For them, canoeing and kayaking are self-reliant forms of recreation and part of a human-powered outdoor recreation community that includes hiking, backpacking, mountain biking, rock climbing and mountaineering. Through their eyes paddling has as much in common with other forms of boating as hiking does with driving a car. Casual paddlers are more likely see themselves as traditional boaters, but some of these people consider a canoe or kayak to be a simple, toy-like object that requires little or no skill to operate.

Canoes and kayaks take people to places they cannot reach by using a map, including the internal places of the mind and spirit. No other form of boating provides a more intimate experience with the water and its surrounding environment than does canoeing and kayaking. Whether one knows the joy of paddling a canoe across a wilderness lake - miles from the nearest person, splashing a kayak into the froth of a whitewater stream, or exploring a placid

cove less than a mile from home, their lives are forever enriched by the experience.

Participation

Who Paddles and Why

Throughout history mankind has paddled canoes and kayaks for many reasons. These small craft were used by Lewis and Clark to explore the west, by fur traders to transport their pelts to market, and by the Inuit peoples of the arctic to hunt seals. Today the reasons people paddle these craft are even more diverse. There is no typical profile of a person who goes paddling in a canoe or kayak.

Skilled and experienced paddlers are typically enthusiasts for whom paddling is a major pastime. These paddlers are drawn to one or more paddling activities (see sidebar: *The Paddle's Many Paths*) simply because they enjoy a particular aspect of paddling. Some are nature lovers who view these non-motorized vessels as the best way to experience the natural world. Others enjoy the mystery and discovery of exploring the nation's many remote waterways. Paddlers seeking an adrenalin boost typically gravitate towards whitewater activities such as running steep creeks, jumping waterfalls and floating big powerful rivers, or towards coastal activities such as playing in surf, exploring sea caves, and tackling big waves in the open ocean.

More casual paddlers are often drawn to canoeing and kayaking for the simple pleasures of solitude, relaxation, family fun, and exercise. People also use canoeing or kayaking as a means to engage in other activities such as fishing, hunting, or even partying. Casual paddlers can be people who have taken paddling seriously enough to develop good paddling skills or they can be people who barely know which end of the paddle to place in the water.

Canoeing and Kayaking: An Overview

Just as diverse as the objectives and skill level of people who canoe and kayak are the demographic profiles of those people. Paddlers transcend all walks of life, income levels, geographic location, age, race and sex. Avid paddlers can be found among the ranks of doctors, lawyers, college professors, military officers, Governors, and members of Congress. Former Attorney General Janet Reno and the former Administrator of the Environmental Protection Agency (EPA), Christine Todd-Whitman are both avid paddlers. Participation in paddlesports was once higher among men, but recent data indicates that today almost as many women paddle as men.

The Numbers

A huge number of Americans participate annually in paddlesports, and this involvement increases every year. In fact, kayaking is (according to the available studies) *the* fastest growing segment of the entire boating community with a growth rate of 272% over the past nine years. The National Survey of Recreation and the Environment (NSRE) found that, during 2003, millions of Americans went paddling: 19.6 million paddled canoes, 9.6 million paddled kayaks, and about 22.6 million went rafting. These numbers suggest that paddlesports makes up a substantial percentage of the total annual participation in boating of any kind. The NSRE found that 76.1 million Americans went out in some kind of boat in 2003. All three of these activities show healthy growth over the last nine years, with canoeing growing from 13.8 to 19.6 million (49.93% more), kayaking increasing from 2.6 to 9.6 million participants (272% growth) and rafting growing from 14.9 to 22.6 million participants (51.9% growth).

Future Trends

These impressive participation figures give every indication of continuing to increase. The

NSRE projects canoeing will continue to grow slowly and steadily from 1995 to 2020. This rise will be complemented by an even greater increase in the number of days those folks will spend canoeing. In other words, not only is the canoeing population projected to grow, the number of days this population will spend canoeing should increase even faster. Despite the overall rise in canoeing, some segments of the canoe market are in dramatic decline. For instance, whitewater canoeing has suffered a drastic drop over the last ten to twelve years. The Nantahala Outdoor Center in western North Carolina was at one time the largest whitewater paddling school in the world. Whitewater canoeing made up half of its classes in the late 80's. By the late 90's, in contrast, canoeing was responsible for less than 20% of its classes, and over the last several years canoeing classes are only rarely offered.

Manufacturers, retailers, and outfitters, as well as the ACA instruction program, all indicate that out of all forms of paddlesport, kayaking is experiencing the most explosive rise in demand. Canoeists still outnumber kayakers about 3 to 1, but with the relative growth rates that situation should not last long. For example, the decline in the Nantahala Outdoor Center's number of canoeing courses over the past two decades has been easily offset by the rising demand for kayaking instruction. This trend is apparent all over the United States, although there are "pockets" where canoeing remains very popular. The upper Midwest and the New England states remain canoeing strongholds, possibly due to strong traditions, and the type of paddling trip most popular in those regions—long trips with frequent portages around rapids or between closely situated lakes is much easier with a quickly unloaded and reloaded canoe than with a kayak. Unlike the canoeing market where, despite the overall increase, certain types of boats (such as whitewater canoes) are becoming less popular, the kayaking

Canoeing and Kayaking: An Overview

market is rising across the board. Sea kayaking, especially, shows healthy increases. This increase, however, is dwarfed by the meteoric demand for the inexpensive, easily accessible, and versatile “recreational kayak.”

Recreational paddlesport in its many forms is easy to access in all 50 states and is generally regarded as fun, healthful, non-damaging to the environment, and inexpensive. For these reasons paddlesport will continue to grow rapidly in the near future. Furthermore, paddlesports has strong participation from a variety of demographic groups. For example, women make up nearly 50% of paddlesport participants (whereas in motorized craft, female participation is much lower). Minorities are also well represented. Furthermore, both populations’ participation is increasing.

Unique Hazards

While the vast majority of paddlers have safe, enjoyable experiences, hazards do exist. Many factors can increase or decrease a paddler’s exposure to risk. Venue, conditions, experience, training, preparation and judgment can all play a part in how likely a paddler is to have an accident. These factors are often related and a comprehensive approach to safety can make the difference between a safe, pleasant day on the water and one that includes a brush with danger, an injury, or even a fatality. Since the risks inherent in paddlesport are often different from the risks of other watersports, it is important to know the unique hazards of paddling.

Water itself is one of the great, unrecognized hazards. Because of the nature of the crafts, the paddler is more likely to end up *in* the water than other types of boaters. A responsible paddler should always assume that he or she is likely to get wet. A vital part of enjoying paddlesports in a safe manner is the awareness that water can be cold and deadly. A serious obstacle to instilling this vital concept

in many potential victims is that they don’t consider themselves as “paddlers” per se, don’t seek out instruction, and often ignore paddler-specific safety education. For example, many hunters who practice flawless gun safety venture out into paddlecraft without adequate knowledge of its risks and basic safety skills, or without paddling safety equipment



Photo: Wiley Wales

Watercraft Size and Stability

The size and stability of canoes and kayaks are key risk factors which far too many people do not fully appreciate. Being relatively small and narrow, these craft require a special attention to issues such as balance and wave action. Inexperienced paddlers often make critical mistakes such as standing in or leaning over the edge of a canoe. These actions dramatically change the center of gravity and increase the likelihood of a capsize.

Due to the size and stability of a craft, a certain level of skill and attention is required to safely navigate in choppy waves, wind or strong current. In today’s world people may be unwilling

Canoeing and Kayaking: An Overview

to take the time and effort to acquire the basic skills and knowledge needed to operate a canoe or kayak safely.

Any circumstance that increases the likelihood of a person swimming in the water without a PFD may likely result in fatalities. Each year more than 4,000 people in the United States die from drowning. Many of these fatalities occur in the relative safety of a swimming pool. It should be no surprise then, that when people end up swimming in the variable waters of a river, lake or ocean without benefit of a PFD, a significant number of fatalities occur. The greater likelihood of swimming associated with canoeing and kayaking, along with the other unique aspects of these activities, brings into question the value of viewing and approaching canoe and kayak fatalities the same as those resulting from other boating activities.

Perception of Skill Required

The narrative descriptions of fatal canoeing and kayaking accidents reviewed by the ACA indicate that many of the victims exhibited little or no paddling skills and failed to practice even the most basic safety precautions. This raises a concern that many people who operate a canoe or kayak do not take the craft seriously or perceive the associated safety risks. It appears that the simplicity of design that characterizes a canoe or kayak is often misinterpreted as operationally simple or inherently safe.

Impact of Weather Conditions

The challenges presented by various weather conditions are an integral part of paddling. Weather can have an enormous impact on the operation of a canoe or kayak, particularly for the inexperienced paddler. Wind can quickly turn a pleasant paddle on a placid lake into a very challenging paddle. Rain falling miles away can change a calm river into a pushy torrent. Cold

weather and rain can sap a paddler's energy, cause hypothermia, and greatly reduce the margin for error.

Experienced paddlers understand the significant role weather plays in canoeing and kayaking, and prepare accordingly. Checking weather forecasts, knowing personal limitations, and wearing proper clothing, including a lifejacket, are key to having a safe and enjoyable paddling experience. Those who fail to understand and prepare for the risks associated with different weather conditions significantly increase the possibility of a fatal accident.

Low-Head Dams

Low-head dams are one of the most dangerous features encountered by river paddlers. Unfortunately, these are common on many rivers (not primarily whitewater ones) and often do not look overly threatening. In fact, these dams can be virtually "invisible" from the low sight angle afforded by a typical upstream paddlecraft, until the boat is too close to the dam to escape the powerful currents. These dams are usually easy to avoid, but too many people are uninformed about their potential deadliness. Paddling literature and courses put special emphasis on the dangers of these dams and stress the importance of recognizing and avoiding them.

Strainers (Sweepers)

Paddlers on rivers and in ocean currents must be particularly cautious around trees or other obstacles in the water that permit water to pass through while retaining solid objects. The current can push boats or swimmers toward the strainer, causing them to become entrapped. It is important that all paddlers understand the potential risks of such obstacles, be able to recognize these hazards, and have the skills to avoid them.

Canoeing and Kayaking: An Overview

Whitewater and Surf Zone

Whitewater is created when fast moving water flows over, around, or through obstacles in the riverbed. The gradient of a river increases the velocity of the water and obstacles (river features) create wave action ranging from mild to extreme. Whitewater presents a whole set of challenges and hazards that cannot be thoroughly covered in this document. Those wishing to paddle on whitewater rivers, even moderate ones, must seek competent instruction and learn the risks involved. Most whitewater paddlers *are* adequately prepared and outfitted. A large percentage of the fatalities associated with whitewater involve highly competent, well-outfitted paddlers who are challenging themselves by attempting to paddle in extreme conditions. These paddlers are making an informed decision to expose themselves to the many hazards found in these conditions.

Many Coastal areas are subject to surf conditions that can be hazardous. Surf conditions change frequently, sometimes very rapidly, and even moderate waves can be powerful. Waves and/or current can push unwary paddlers into obstacles such as rocks, piers, jetties, and other boats. Piers and fallen or floating trees form dangerous strainers and even a sandy shore can be dangerous if a boater is propelled onto it out of control. All users of the surf zone - boaters, swimmers, fishermen and others - need a significant level of knowledge and skill before venturing out.

Remoteness

More adventurous paddlers often seek out remote places to paddle and experience nature on its own terms. This remoteness can be an inaccessible river gorge only a few miles from a highway or it can be a vast wilderness a

hundred miles from the nearest person. This remoteness also greatly decreases a paddler's margin of error. Even a minor miscalculation can have fatal consequences.

The most common problem with remote locations is evacuating an injured person. This is one reason experienced paddlers typically venture into these areas with other paddlers that are equally skilled in wilderness travel and first aid. In places like Alaska, kayakers are often dropped by plane or charter vessel at wild and remote locations. In such environments paddlers must carry extra rescue and medical supplies in case weather conditions delay their return or prevent a scheduled pickup.

Managing the Risks

One basic way to improve paddler safety on the water is to respect the power of natural forces such as current, wind, waves, and weather and to respect human limitations in the face of these natural forces. We don't breathe water, so we all need to wear a life jacket. The water can cool us rapidly, so we need to wear adequate protective clothing. Our muscle strength is nothing compared to the forces we will encounter while paddling, so we need to develop skills to help us work with the water, not against it. In order to know when the conditions are too threatening, all paddlers need to be able to recognize and avoid hazards. Knowledge, and to some extent skills, can be learned from books, videos, signs, and other media, but the most effective means for passing along safety information is through well-designed courses taught by qualified instructors. Warning and informational signs, books, videos, and public awareness media campaigns should all strongly recommend that the participant seek competent guidance and instruction.

Canoeing and Kayaking: An Overview

Basic Safety Knowledge

Safety is—first and foremost—an attitude. The prudent paddler can recognize hazards, assess risk, know his or her limits, and exercise good judgment. Beyond this safety first attitude, knowing the following important safety practices will help make any paddling experience a safer one. The prudent paddler should

- Know the importance of wearing a PFD, regardless of one's swimming ability.
- Never drink alcohol immediately prior to or during a paddling trip.
- Understand the limitations of the vessel with respect to size, carrying capacity, stability and designed purpose.
- Plan ahead. Research the venue; check the weather, and make sure skill level, equipment and provisions are adequate for the trip.
- Know how to swim; even with a life jacket on being comfortable in the water is a big advantage in case an unexpected capsizes occurs.
- Never paddle alone. There is safety in numbers. More eyes to look for hazards, more minds to assess risk, more hands to help with rescues. Consider the skills of paddling partners and their ability to help in the event of capsizes.



ACA Stock Photo

Proper Gear and Clothing

Many of the annual paddling fatalities and serious injuries in the U.S. involve paddlers who are ill equipped for the conditions. Hypothermia, for example, is a major threat but can be offset by proper gear and a good knowledge of how to stay warm even when wet. It is essential that all gear is well suited to the type of paddling planned. Canoes and kayaks vary widely in their design and intended uses, and fatalities can and do result from paddlers taking a craft designed for a lake onto moving water or onto the ocean. Kayaks designed for open ocean-touring lack the maneuverability required for running whitewater and can be quite hazardous if taken on rivers requiring “tight moves.” The many issues involved in matching gear to conditions cannot be covered here, but it is essential to know and respect a craft's intended uses and limitations.

The most important and basic rule of paddling is: **Wear a lifejacket (Personal Flotation Device or PFD)!** Unfortunately, this practice is not ingrained in the minds of many casual paddlers. This may be in part because of the PFD ethic people develop while operating larger boats. On these larger - typically motorized - vessels the operators often do not wear the lifejackets; they simply have them onboard.

Paddling Skills

A chief pleasure of paddlesports is that the paddler relies only on his or her own physical skills to propel the craft. Hazards, however, arise when paddlers do not have the skills needed. It is imperative that all paddlers practice the skills needed to handle a canoe or kayak. Those basic skills should include

- Knowing how to balance the boat and keep it from capsizing. This includes entering and

Canoeing and Kayaking: An Overview

exiting without turning over or falling out, and performing all maneuvers necessary with the boat upright.



Photo Courtesy of Dagger, Inc.

- Being able to propel the boat in a (relatively) straight line.
- Being able to turn the boat in either direction quickly and efficiently – preferably, even in waves and current.
- Being able to stop the boat’s forward progress, and back up at least a short distance.
- Rescue and recovery skills. A paddler should be able to quickly perform a “self rescue,” and should be able to effectively assist with the rescue of others (see *Rescue* below).

No one should venture out onto water without training and assume that he or she is instinctively prepared to meet any circumstance. Experience does not equate with knowledge or skill. Many people operate canoes and kayaks for years without developing paddling skills or practicing basic safety. Being lucky enough not to have an accident does not make one a safe and capable paddler. All paddlers should educate themselves, either by reading available literature

or by seeking qualified instruction, preferably both.

Rescue

Because canoes and kayaks are smaller and have a different hull design than typical motorized craft, the risk of capsizing can be higher and avoiding capsizing is more dependent on the skill of the operator. Recognizing this, all paddlers must also know what to do in the event of an upset and be skilled in getting themselves and their gear to shore or back into the boat. Many kayaks and certain types of canoes can be rolled back to the upright position after capsizing while the operator is still in the craft. In decked boats such as touring or whitewater kayaks and properly designed and outfitted open boats such as whitewater canoes, rolling can allow the boater to continue paddling immediately. Learning and practicing self-rescue and recoveries are integral and important responsibilities of prudent paddlers.

Paddling with a well-trained and supportive group improves the safety of each member of that group. Some or ideally all of the group should be trained in rescue and recovery, have taken first aid and CPR classes, and share common goals and interests regarding the paddling trip. Watching out for each other is simply an accepted part of paddling for all experienced paddlers.

U.S. Canoe and Kayak Fatality Analysis 1996-2002

Introduction

This report includes six years of accident data from the US Coast Guard (USCG) Boating Accident Report Database (BARD). There are changes to the USCG criteria for reportable accidents that could compromise the comparability between data reported in the first edition of Critical Judgment and data added for this updated reports. These changes in criteria became effective May 25, 2001. Changes in reporting criteria applied to situational aspects of boating accidents might expand the scope of reportable accidents. Please note the USCG only requires accidents that occur on public waterways, lakes and pond to be reported.

The changes in reporting criteria tend to increase the number of reported canoe and kayak fatalities in 2001 and subsequent years due to the expansion of situations in which accidents are considered reportable. A sizable change in property damage dollar amount, from \$500 to \$2000, is not expected to affect reported numbers of canoe and kayak fatalities because all fatalities are required by the USCG to be reported regardless of property damage.

Overview

From calendar year 1996 through 2002, 574 fatalities associated with canoes and kayaks were reported to the U.S. Coast Guard. For 16

Table 1: Canoe and Kayak Fatalities by Vessel Type, 1996-2002

Vessel Type	Percent
Canoe	72%
Kayak	28%
Total Observations 558	

Note: Vessel Type unknown= 16
 Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

of the reported fatalities, the exact type of boat paddled was not reported. Among the 558 paddling fatalities for which type of vessel is known, 72% were associated with canoes (Table 1), down 3% from the previous report. The remainder 28% was associated with kayaks. Sea kayaks represented a very small proportion of fatalities (1% overall and 5% among kayaks)

Table 2: Canoe & Kayak Fatalities by Year

Year	Canoe	Kayak	Total Number
1996	77%	23%	43
1997	72%	28%	83
1998	77%	23%	90
1999	77%	23%	79
2000	74%	26%	103
2001	70%	30%	93
2002	58%	42%	67

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

Exposure Data

Exposure is essentially the amount of time a vessel operator spends operating a certain vessel. In 2000, a USCG supported survey conducted by JSI Research and Training Institute, Inc. attempted to assess the safety risk associated with various types of boating by comparing the number of accidents and fatalities with the total exposure. Two factors play a role in the exposure rate associated with a particular vessel type. One is the total number of vessels of that type in operation. The other is the amount of time operators spend operating the vessel. The JSI survey reported that canoeist and kayakers had a higher fatality rate per hours of exposure than other types of boating.

The ACA found a serious sampling error in this survey and reported it to USCG. Both JSI Research and Training Institute, Inc. and USCG acknowledge that the sampling method used for the JSI study relied too heavily on registered boat owners and thus failed to accurately assess canoe and kayak exposure data. Since only a small portion of canoes and kayaks are required to be registered, a survey of registered boat owners would primarily capture motorized boat owners that also happen to own a canoe or kayak. These owners would probably spend less time in a canoe or kayak than those who only own a canoe or kayak. The ACA provided USCG with contact information on paddlers that will hopefully help the next survey produce more reliable results.

U.S. Canoe and Kayak Fatality Analysis 1996-2002

The number of reported fatalities among canoes and kayaks had been increasing over time. It is likely that in part this reflects increased participation in paddle sports over the same time period. However, data from the two most recent years indicate that this trend may have reversed. Another change is observed in the proportion of fatalities involving canoes. From 1996 to 2000, roughly three quarters of reported fatalities that involved a paddle-powered boat were associated with canoes (Table 2). In 2002 a distinct shift occurred in the number of reported fatalities associated with kayakers and

Table 3: Capsize Fatalities by Type of Boat, 1996-2002

Boat	Did Not Capsize	Capsized	Total
Canoe	24%	76%	393
Kayak	22%	78%	143

Pearson chi2(1) = 0.2 Pr = 0.6

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

the ratio of accidents associated with canoes dropped to almost one half.

Accident Types

The USCG data provide information on the type and cause of boating accidents. Among canoes and kayaks, the majority of fatalities, 76%, were classified as “capsizes” by the USCG. Other possible classifications were “fell overboard,” collision with fixed or floating object, swamped boat, and “other.” Out of 574 canoe/kayak fatalities, 24 were not assigned to any of these categories.

A review of accident narratives indicates that a significant number of canoe accidents classified as “capsizes” also involved a person falling

Table 4: Canoe and Kayak Capsize Fatalities by Water Conditions, 1996-2002

Water	Did Not Capsize	Capsized	Total
Choppy Rough, Very Rough	22%	78%	225
Calm	25%	75%	219
Total Observations	104	340	444

Pearson chi2(1) = 0.4 p = 0.5

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

overboard. Often a person standing or moving around in a canoe loses his or her balance and falls over the side of the canoe. Since these falls typically capsize the canoe, the resulting accident is classified as a capsize.

When examined by type of boat, it appears that there is no difference in probability of capsizes between canoe and kayak fatalities (Table 3). Also there was no firm evidence that alcohol consumption increased the likelihood that a fatality was due to capsize (Odds Ratio: 0.9, C.I.=0.6-1.5).

Interestingly, capsize fatalities appear to be as likely to be found on calm water as on choppy, rough or very rough water. As can be seen from Table 4, among all fatalities that occurred on “calm” water, 75% were capsizes. Among fatalities that occurred on choppy, rough or very rough water, 78% were classified as capsizes.

Accident Causes and Risk Factors

When evaluating the causes of canoeing and kayaking accidents and the risk factors associated with the resulting fatalities, the causes identified in the USCG BARD are of limited value. Causes typically reported include: operator inexperience, operator error, skier/passenger/other, alcohol, hazardous water/weather, and

U.S. Canoe and Kayak Fatality Analysis 1996-2002

Table 5: Detail of Kayak Fatality Causes Based on Up to Three Reported Causes

Causes	Canoe Fatalities	Kayak Fatalities
Hazardous Water / Weather (only)	20%	46%
Operator Inexperience or Error (only)	22%	17%
Skier / Passenger / Other (only)	7%	1%
Alcohol (only)	8%	1%
Hazardous Water / Weather + Operator Inexperience or Error	10%	16%
Hazardous Water / Weather + Alcohol	2%	1%
Hazardous Water / Weather + Other	4%	8%
Operator Inexperience or Error + Alcohol	8%	5%
Operator Inexperience or Error + Other	3%	1%
Alcohol + Other	5%	0%
Alcohol + Operator Inexperience or Error + Hazardous Water / Weather	1%	0%
Alcohol + Operator Inexperience or Error + Other	1%	2%
Alcohol + Hazardous Water / Weather + Other	<1%	0%
Hazardous Water / Weather + Operator Inexperience or Error + Other	0%	0%
All Other	13%	10%

The total number of fatalities represented in this table: Canoe = 347, Kayak = 136

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

other. Table 5 breaks down the causes of canoe and kayak accidents as they are presented in USCG BARD.

The USCG data report up to three causes for each reported fatality. Using all three causes and breaking fatalities down by type of boat, provides evidence of differences in causal factors between canoe and kayak deaths (Table 5). Operator inexperience or inattention and hazardous water or weather by themselves, or combined with other factors, were the major causes of canoe and kayak fatalities. These factors accounted for 76% of all canoeing fatalities, and for 90% of all kayaking fatalities.

Alcohol use was another significant contributing factor in canoeing fatalities, listed as a causal factor in 25% of canoeing deaths. Among kayakers, only 9% of fatalities involved alcohol use. This difference in proportions is statistically significant. Passenger involvement played a role

in 16% of canoe fatalities but only 3% in kayak fatalities.

For the purposes of this report, any category including alcohol as a causal factor was counted as alcohol involvement. If hazardous water or weather and alcohol were causal factors, the fatality was tabulated as an alcohol-related fatality. Consequently, proportions presented for hazardous water or weather and operator inexperience or inattention includes only non-alcohol related fatalities.

The cause-related categories used by boating officials and reported in BARD are helpful in understanding generally what contributes to fatal accidents, they are not specific enough to reveal the details of what actually happened. For these specific details, the most useful information is contained in the accident narratives captured in BARD and the information presented on PFD use. The ACA has used all of this information in determining

U.S. Canoe and Kayak Fatality Analysis 1996-2002

the primary causes and risk factors associated with most canoe and kayak fatalities.

Occupant Movement / Weight Shift

The ACA is convinced that occupant movement and weight shift within a canoe plays a major role in the majority of all canoeing fatalities. The BARD data indicate that many of these fatalities occurred in calm water and weather conditions.

Typical behaviors that result in such capsizes include: occupants switching positions, an occupant leaning over the side of the canoe to retrieve something from the water, horseplay, casting a fishing rod, and occupants standing up in the canoe. Here are a few examples of the narrative accounts of these accidents

- Four men were in a canoe. One of the four was tipping the boat. The others asked him to stop, and when he shifted his position, he caused the canoe to capsize. The man tipping the boat went under and drowned. Alcohol was a factor, as the deceased had reportedly been drinking.
- Three adults and two Black Labs were in a canoe on backwater going to a friend's house. One of the victims stood up to relieve himself. When he did, the canoe turned over.
- Three men were fishing. While passing under a low tree a snake startled the men and they capsized the boat.
- Victim was fishing off dock on the river. His fishing line got hung up in the water. He got in a canoe to get the line out. As he was attempting to free the line the canoe turned over. Victim fell in water and drowned.
- The vessel capsized when the occupant stood up to land a fish.
- A woman and her husband were out in their aluminum canoe fishing. They had just started paddling across the pond when the man dropped something into the water. He

leaned over the edge to retrieve the object and the canoe capsized.

Capsizes due to occupant movement / weight shift were prevalent both in accidents where alcohol was involved and in accidents not involving alcohol. The narrative accident descriptions suggest that these capsizes are

Table 6: Canoe and Kayak Fatalities by Vessel Type and PFD Use, 1996-2002

	Canoe	Kayak	Unknown
PFD Worn	14%	52%	6%
PFD Not Worn	85%	48%	94%
Unknown	1%	—	—
Total Fatalities	403	155	16

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

most often associated with inexperienced occupants and with the use of a canoe for activities such as fishing.

Personal Flotation Device (PFD) Use

PFD non-use is the single most prevalent risk factor among canoe fatalities. While the reasons paddlecraft occupants end up swimming in the water are varied – including causes such as wind, wave action, occupant movement, swift current, and overloading the vessel – the vast majority of those who do not survive such mishaps are not wearing a PFD.

In canoeing and kayaking fatalities, three quarters were not wearing a personal flotation device (PFD). Among fatalities who had been paddling canoes at the time of death, 85% were not wearing a PFD (Table 6). The odds that individuals who were paddling kayaks when they died were wearing a properly worn PFD was over six times that of their counterparts in canoes (Odds Ratio=6.3, 95% Confidence Interval= (4.1-9.5). However, nearly half of the fatalities among kayaks were also not wearing PFDs.

U.S. Canoe and Kayak Fatality Analysis 1996-2002

Since non-fatal canoeing and kayaking accidents rarely meet the reporting criteria, there is not much information about people's use of PFDs among those involved in canoe and kayak accidents who did not die. Still, a great deal about the role PFD use plays in the survivability of these accidents can be derived from the narrative descriptions of fatal accidents. ACA reviewed available narratives for canoe and kayak accidents where there were multiple occupants in a canoe or kayak when a capsized occurred. Invariably, those who were wearing a PFD survived and those who were not wearing a PFD perished.

The following accident descriptions are typical of what the ACA found.

On May 23, 1998 four young males were in a canoe on Moore Lake in Minnesota. The canoe capsized while one of the occupants was removing his shirt.

Table 7: Canoe & Kayak Fatalities by PFD Use, 1996-2002

Year	No PFD	PFD Worn	Total Fatalities
1996	74%	26%	43
1997	77%	23%	83
1998	83%	17%	86
1999	72%	28%	82
2000	68%	32%	105
2001	85%	15%	99
2002	69%	31%	72
7-year Avg	76%	24%	570

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

All occupants except the man who removed his shirt were wearing a PFD and survived. The man without a PFD struggled, went under, and drowned.

On July 25, 1998 a family was paddling a canoe on a pond near Fairbanks Alaska and the canoe they were in capsized. The man told his wife and 5-year-old daughter to swim to shore. The wife and daughter, who were both wearing PFDs, successfully reached

the shore. The man, who was not wearing a PFD, failed to reach the shore and drowned.

One of the few published studies that looked at PFD use in a general population, Quan et al. (1998) found that in the state of Washington in 1995, kayakers had the highest rate of PFD use (78%) while canoeists averaged 41%. If these rates are representative of PFD use rates among paddlers in the entire US, then PFD use among fatalities reported to the USCG is lower than that what would be found among non-fatalities. Over the five-year period from 1996-2000, 28 fatalities occurred in Washington where Quan et al conducted their study. Among these 28 fatalities, PFD use averaged 25%, well below the rate they found among the general paddling population in that state. This lends additional support to the belief that failure to wear a properly fastened PFD contributes to canoe and kayak fatalities.

The tabulations in Table 7 indicate a steady trend of decreasing PFD use among paddling fatalities from 1996 to 1998. This trend appears to reverse after 1998 for two years, and then declines in 2001 only to rise again in 2002. Only additional information about PFD use over time would provide a definitive explanation of these observed patterns among fatalities.

Other risk factors for canoe and kayak fatalities such as alcohol impairment, rough or choppy water, strong currents, cold water, and inexperienced paddlers may have a direct influence on a person's likelihood of wearing a PFD. For example, individuals who know they will be paddling rough water may be more likely to wear a PFD, whereas individuals paddling calm water may be less likely to wear a PFD or more likely to consume alcohol. The following tables show the distribution of these factors among canoe and kayak fatalities over the study period.

In order to determine the interplay between PFD use and various other risk factors

U.S. Canoe and Kayak Fatality Analysis 1996-2002

Table 8: Correlates of PFD Use Among Canoe & Kayak Fatalities, 1996-2002

	OddsRatio	95%Confidence Interval
Choppy, Rough, or Very Rough Water	2.2	(1.2-3.8)
StrongCurrent	2.0	(1.2-3.3)
Alcohol Involved	0.6	(0.3-1.1)
Kayak	4.4	(2.6-7.4)

*Likelihood Ratio $\chi^2(4)=80.0, p<.001, n=441$
Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002.*

associated with USCG reported fatalities, we use a method called logistic regression that allows us to estimate the strength of the association between another risk factor and PFD use while controlling for other risk factors that may have been present. In this way, we hope to be able to say something about PFD use relative to other risk factors including how these risk factors may influence PFD use.

Table 8 provides odds ratios that measure the relative importance of several different risk factors in determining PFD use. Each odds ratio measures the effect of that risk factor on PFD use while holding all other risk factors constant. For example, individuals who were paddling choppy, rough or very rough water at the time of death had odds of PFD use that were twice that of individuals paddling calm water at time of death (O.R.=2.2, 95% C.I.=(1.2-3.8-4.2)) regardless of what type of boat they were paddling, whether or not there was a strong current and whether or not they had consumed alcohol.

The odds of PFD use among individuals paddling in strong current were two times that of individuals paddling calm water with no strong current regardless of the other risk factors. When these two characteristics of the water are controlled, notice the odds ratio for PFD use among kayakers falls from six (described in the introduction without controlling other risk factors) to four (O.R.=4.4, C.I.=(2.6-7.4)). This change in the odds ratio when a new variable is controlled suggests among reported fatalities, kayakers were more likely to be paddling rough or choppy water or in strong current. In fact, in this data set, the odds kayakers were paddling rough or choppy water at the time of death were nearly five times that of canoeists (O.R.=4.5, 95% C.I.=(2.8-7.4)).

As can also be seen in Table 8, alcohol use lowers the odds of PFD use by about 40% even when water conditions and type of vessel are controlled (O.R.=0.6, 95% C.I.=(0.3-1.1)). It should be noted, however, this effect was not statistically significant at conventional levels. We found some evidence (reported below) alcohol use is correlated with other factors that can affect fatality risk.

Paddler experience is not included in this regression due to the large number of observations for which this variable is missing. When experience is included in this regression, the results in Table 8 are unchanged except for alcohol involvement where the odds ratio rises to 0.8. Fatalities in the two more experienced

Table 9: Paddler Experience and PFD Use Among Canoe & Kayak Fatalities, 1996-2002

Hours	OddsRatio	95%Confidence Interval
10 -100	1.9	(1.0-3.8)
>100	4.0	(2.0-7.8)

*Likelihood Ratio $\chi^2(2)=17.1, p<.001, N=323$
Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002.*

U.S. Canoe and Kayak Fatality Analysis 1996-2002

categories had much higher odds of PFD use compared to the least experienced group (1.5 and 2.7 respectively).

Among the boating fatalities in this data set, more experienced paddlers were more likely to be wearing a PFD when they died (Table 9). Individuals who were reported to have less than 10 hours of experience were least likely to be wearing a PFD at death. The odds of PFD use among fatalities with 10-100 hours were two times that of the least experienced fatalities. The odds of PFD use among fatalities with more than 100 hours of experience were four times the odds of PFD use among the least experienced fatalities. Of course, these results should be viewed as somewhat tenuous, since “experience” was reported for only 56% of all known canoe or kayak fatalities.

There is some evidence in the US Coast Guard data that with the exception of alcohol use, PFD use increases with risk factors commonly thought to be associated with a higher probability of capsize, such as rough or choppy water. This suggests that among paddlers who died, PFD use may have been influenced to some extent by perceived risk of misadventure while on the water. Fatalities paddling relatively calm water tended not to be wearing a PFD when they died. Unfortunately, it appears that calm water may foster other high-risk behaviors as well. Alcohol

appeared to be a factor in proportionately more deaths on calm water than on choppy, rough or very rough water.

Only research that collects data on both nonfatal and fatal boating can ever answer the PFD question with certainty. However, based on the USCG data, it appears that individuals who died boating and who were wearing PFDs tended to be more experienced, were more likely to be paddling on rougher water and were more likely paddling a kayak. Those who were not wearing PFDs at time of death appear to have been less experienced, were more likely to have consumed alcohol, and were more likely to have been paddling a canoe.

Water and Weather Conditions

Water and weather conditions are a significant factor in many canoe and kayak fatalities. While

Table 11: Canoe and Kayak Fatalities by Strong Current 1996-2002

	Percent
Current Not Strong	62%
Strong Current	38%
Total Observations:	459

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

canoes and kayaks are very capable of handling rough water conditions, much of this capability depends on the skill of the operator. Experienced paddlers regularly navigate rough water successfully, but when an inexperienced paddler encounters waves or strong current there is a much higher risk of capsizing.

From the figures in Table 10, it appears that fatalities were evenly divided between calm water and water classified as choppy, rough or very rough by the USCG. It is likely that the majority of people in the U.S. who go canoeing or kayaking prefer to paddle on relatively calm waters, such as small lakes, ponds, and quiet

Table 10: Canoe and Kayak Fatalities by Water Condition 1996-2002

Water	Percent
Calm Water	49%
Choppy, Rough, very Rough Water	51%
Total Observations:	459

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

U.S. Canoe and Kayak Fatality Analysis 1996-2002

Table 12: Canoe and Kayak Fatalities by Water Temperature 1996-2002

Water Temperature (F°)	Percent
<50° F	33%
51°-65°	38%
> 65°	28%
Total Observations: 394	

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

Table 13: Canoe and Kayak Fatalities by Operator Experience 1996-2002

Hours	Percent
<10 hours	29%
10-100 hours	39%
Over 100 hours	31%
Total Observations: 323	

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

Table 14: Correlates Alcohol Use Among Canoe & Kayak Fatalities, 1996 - 2002

	Odds Ratio	95% Confidence Interval
Canoe	1.8	(1.0-3.3)
Calm Water	1.6	(1.0-2.4)
Likelihood Ratio $\times^2(2)=11.4$, $p<.001$, $N=441$		

Source: US Coast Guard Recreational Boating Accident Report Database (BARD), 1996-2002

rivers. A smaller proportion of boaters, usually kayakers, prefer the greater challenge of whitewater boating and an even smaller proportion enjoy the risks of ocean kayaking. The roughly equal proportions in Table 10 are difficult to interpret since we don't know what the relative rates of exposure are to the two types of water conditions. Some of those in the rough water category are probably risk-preferring whitewater boaters and sea kayakers, while some are canoeists and kayakers who were caught in storms on open water.

Table 11 indicates that the majority of canoe and kayak fatalities do not occur in strong current

(62%). Again, risk preferring whitewater boater fatalities would be expected to fall into the "strong current" category.

Hypothermia due to cold-water exposure is also a paddler risk factor for death. In the USCG data, just under three-quarters of all fatalities where water temperature was known occurred in water below 65 degrees Fahrenheit (Table 12).

Operator Experience

Another risk factor for mishap and injury among paddlers is inexperience. Information on experience is only available for 323 of the 574 known canoe and kayak fatalities in the USCG database. The majority of these fatalities had more than 10 hours of experience (71%) with just less than a third reporting more than 100 hours of experience (Table 13).

Alcohol Use

The odds of alcohol use were almost twice as great among fatalities occurring on calm water (O.R.=1.6, 95% C.I. = 1.0-2.4) (Table 14). Also, the odds alcohol was involved in the fatality nearly doubled if a canoe was paddled rather than a kayak (O.R. 1.8, 95% C.I.=1.0-3.3).

Man-made Hazards

Dams and weirs and other man-made hazards contribute to numerous canoe and kayak deaths each year. Dams often present a greater hazard to paddlers than natural river features. Because of their uniform shape, dams typically create powerful hydraulics that will hold and recirculate anything near the face. As noted in the *Unique Hazards* section earlier, low-head dams are particularly problematic. These dams are often only a few feet high and appear benign to people who are unaware of the hydrology associated with them.

U.S. Canoe and Kayak Fatality Analysis 1996-2002

The circumstances surrounding dam-related deaths vary, but some scenarios are more common than others. Often paddlers are involuntarily swept over a dam by current. Typically the paddler either underestimated the force of the current upstream of the dam, or underestimated the force of the water below the dam. Large flood control and hydroelectric dams can pose an unseen risk to paddlers downstream by releasing large volumes of water that can quickly and dramatically change the character of a river.

In addition to dams and weirs, other common man-made hazards for paddlers include fences placed across streams, bridge piers (abutments), low-water bridges, culverts, and large trash (such as old cars and washing machines) discarded in rivers. These man-made hazards are most problematic in swift moving water, where they pose pinning or entrapment hazards.

Other Vessels

The extent to which other vessels contribute to canoe and kayak fatalities is harder to determine. In its review of narrative accident data, the ACA found only a few fatal accidents positively identified as involving another vessel. There are, however, a significant number of fatal capsizes un-witnessed and where the cause of capsize is unknown. Many paddlers have reported accidents and near accidents resulting from the operation of motorized craft.

The narrative descriptions of fatal accidents involving canoes or kayaks and other vessels, while few in number, do point out the risk to paddlers that other vessels can present.

The operator was towing a person on a kneeboard. There was an observer present, but the operator turned around to look at the kneeboarder and when doing so, failed to see an anchored canoe not far from shore and ran over it. The accident killed a

passenger in the canoe and severely injured its operator.

A 30-year-old man lost his life when the 14-foot canoe from which he was fishing capsized. The canoe was in an area where several powerboats were operating and was apparently struck by a wake.

A canoe was operating on the Buffalo River with three passengers and no personal flotation devices. Vessel B passed closely at a high rate of speed and its wake caused the canoe to swamp and sink. The victim was not able to stay above water.

Some boaters and boating officials have raised questions about the low profile of touring kayaks and whether they are visible enough to other vessels, however, nothing in the BARD accident data or in the accident descriptions reviewed by ACA indicate that the low profile of a kayak has played a role in boating accidents or fatalities. Many other objects in the water, such as marine mammals, debris, and certain types buoys have a similarly low profile. This potential risk is greatly reduced by boaters maintaining proper lookout.

Accident Victims

Key to the ability of ACA and others to reduce the number of canoeing and kayaking fatalities is an understanding of the identity of the victims. All of the data analyzed in this report reveal information about accident victims. For example, the report shows that most victims were paddling canoes and not wearing a PFD. Beyond that, ACA cross-referenced information from the general accident report, vessel information in the BARD, and narrative descriptions of the fatal accidents. Through that research ACA also concludes that the following information.

- Approximately 90 % of canoeing and kayaking fatalities are male.

U.S. Canoe and Kayak Fatality Analysis 1996-2002

- Approximately 50 % of victims categorized as canoeing and kayaking fatalities were fishing when the accident occurred.
- Approximately 40% of canoeing fatalities for which information is available were in aluminum canoes at the time of the accident.
- Victims of fatal canoeing accidents most commonly were operating inexpensive canoe brands at the time of the accident.
- At least 25% of victims in canoeing related fatalities are believed to have consumed alcohol immediately prior to the accident.

While ACA research was able to derive some valuable victim information from the USCG, there are many gaps and inaccuracies in the reporting of canoe and kayak fatalities. Basic information such as the type of canoe or kayak, vessel hull material and manufacturer, and gender of the victim were either absent or incorrect for many accident reports. This information needs to be as complete and accurate as possible in order for ACA and others involved in boating safety to effectively target and impact the individuals at highest risk of having a fatal accident

Human Error And Canoe Accidents

It is important to look at results of other research efforts to verify ACA observations. The following analysis is supplied by Dr. James McKnight of the Marine Safety Foundation. This Foundation recently completed an analysis of human error involved in over 3000 fatal and non-fatal boating accidents reported to the US Coast Guard. The sample included 220 canoe or kayak accidents.

Based on these findings, the leading contributor to fatal accidents was the failure to wear a PFD under conditions creating a significant chance of ending up in the water. The proportion of canoe accidents resulting from this cause exceeded that for any other type of boat. Conditions leading to sudden immersion included strong current (e.g. rapids), rough weather and the poor navigability of the waterway because of rocks, tree limbs and other impediments. Many drownings resulted from failure to stay with the canoe and make use of its flotation, being second only to rowboats in this problem. Failure to have PFDs available to begin with was also second highest to rowboat accidents.

Accidents resulting from lack of sufficient skill in handling canoes involved primarily the same threatening conditions that warranted PFDs, (current, weather, impediments to navigation). Those that could have been avoided had canoeists considered these conditions relative to their own skill in deciding whether to operate at all added up to almost a fifth of all canoe accidents. Inability to handle rough weather or to seek shelter from it when encountered was a factor in about half of these accidents. Much of canoeing takes place along waterways characterized by waterfalls or dams and accidents resulting from failure to check routes in advance for these obstacles were largely confined to canoes. Not looking along the path ahead was less of a problem than for faster moving boats, but many accidents resulted in failure to see other vessels, as well as markers, logs, and trees, among other objects.

Considering the relative instability of canoes, it is not surprising that failure to remain seated led to a large proportion of capsize accidents (exceeded only by rowboats). Specific causes included attempts to change position, move gear, relieve oneself, or horseplay. Paddling too close to other, boats, particularly larger boats, resulted in damage, a problem that was more

U.S. Canoe and Kayak Fatality Analysis 1996-2002

severe when strong wind or current made control more difficult. Several accidents resulted from actions by inexperienced crew, such as playing games, jumping in the water and having the canoe blow away, becoming confused in an emergency, and capsizing the boat while trying to recover gear.

Underlying many of the canoe accidents was the use of alcohol. Along with open motor boats, canoes had the largest number of instances in which alcohol impairment clearly led to accidents, particularly those involving capsizing and swamping. The magnitude of alcohol's role in canoeing mishaps cannot be accurately judged from the information available to accident investigators. However, measures of blood alcohol in recreational boating fatalities show about a third having levels indicative of intoxication (four to five drinks in the system).

Errors differ greatly by boat type. The following lists present human errors resulting in reported accidents for each boat type in the order of frequency from highest to lowest.

Canoes

PFD WEAR – not used when wind, waves, temperature warrant

ALCOHOL – impairment causing capsize, collisions

CURRENT - handling strong current

CAPSIZE – standing, moving, horseplay; swimming for shore

PFD # – lack required number (or any at all)

WEATHER – not stopping, seeking shelter when needed

ROUTE – not checking ahead for rapids, strong current

SKILL/KNOWLEDGE – loss of control, confusion, unsafe acts

PFD COLD – not wearing when cold water causes hypothermia

PFD NON-SWIMMER – not wearing when unable to swim

Kayaks

CONDITIONS – venturing out in conditions too severe

CLOTHING – inappropriate for cold weather, no helmet

ROUTE – not checking for rapids, waterfalls, obstructions

SKILL – insufficient for conditions and attempted activity

WATER – not considering navigability, obstructions (rocks)

WEATHER – not ceasing operation, seeking shelter

SELECTION – wrong type of kayak for route and conditions

Knowing the frequency of errors allows preventive efforts to be directed where most needed and to be targeted to individual groups of paddlers. The ongoing research of the Marine Safety Foundation will no doubt assist ACA and the greater paddlesport community in targeting messages and course content specifically to paddling groups.

Conclusions

If one factor is correlated with another, then simple one-way comparisons may produce misleading results. For example, if most kayak deaths occur among more experienced boaters paddling more difficult, i.e., higher risk, water who always wear PFDs, while canoe deaths occur among less experienced paddlers paddling calm water and not wearing PFDs, then increased PFD use should reduce fatalities among canoeists, but might not have much effect among more experienced kayakers.

There are several problems associated with the USCG data that may compromise the validity of our analyses. The first is "missing data." This problem takes several forms. The first is that the USCG database contains only fatalities that are reported to the USCG. If local officials fail to file a report, then the fatality will not be in the database. Moreover, if the fatality occurred on

U.S. Canoe and Kayak Fatality Analysis 1996-2002

a private lake or pond, officials are not required to file a report with the USCG. Such fatalities may represent a significant portion of total canoe and kayak fatalities (Smith, 2001).

Missing data will not be a problem as long as failure to report is not systematically related to risk factors that were present for the fatality. For example, if individuals are less likely to wear PFDs when boating on private lakes and ponds, then PFD use among fatalities reported to the USCG may actually be higher than in the general population of paddlers. Although this is theoretically possible, there is no reason to believe that PFD use varies significantly or that there are systematic differences in reporting boating accidents that occur on public waterways.

However, it is important to keep this possible source of bias in mind when evaluating the results of this analysis. The more troublesome missing data problem with this data set are all the observations for which vessel type or PFD use or water conditions, etc, are unknown. Operator experience, an important risk factor, was missing for half of all kayak and canoe fatalities. There is also some evidence that the USCG data tends to under-report alcohol-involvement (Smith, 2001). If these data are not missing at random, then again, the results of our analyses will be misleading.

Another missing data problem of the USCG data set is the lack of information about characteristics of the person who died. There is some evidence that teenage boys are at highest risk of drowning from all causes (Newman et al, 1998) and that males in general are at higher risk of injury and injury-related deaths (Smith and Howland, 1999). Quan et al (1998) found that females are more likely to wear a PFD and that PFD use was highest among children under the age of 5 years. Many states currently require children under the age of 13 to be wearing a PFD while in a boat that

is underway, but this was not the case during the entire 1995-2002 study period.

Because we have no information on individuals who were boating during the 1996-2002 period and who were not fatally injured in a canoe or kayak accident, we have no meaningful comparison from which to calculate a relative risk of mortality based on the risk factors described in this report. Use of propensity scores (Rosenbaum & Rubin, 1983, 1984) with quasi-experimental data and comprehensive data on individual risk factors, including education, experience, PFD use, training, number of hours spent paddling, etc, should yield reliable estimates of reductions in relative risk due to PFD use if such data could be obtained.

A Note About Risk

The average human, if she knew with certainty that she would capsize and drown without a PFD, would readily purchase and properly wear a PFD to avoid that fate. The problem in the general canoeing and kayaking public is that the probability of capsizing and drowning appears to be quite small. If we assume that on any given weekend day, there are 10,000 canoes and kayaks paddling America's waterways, then there are $10,000 \times 104 = 1,040,000$ paddler days each year when people are at risk. In the last two years for which data are available, the average number of deaths per year was 87. The unadjusted risk per paddler day is .00008 or 8 fatalities per 100,000 user days.¹ It should be noted that it is likely that this conservative calculation actually overstates the risk since the NSRE's figures indicate that over 30 million people paddled canoes or kayaks in 2003.

Adding in every lake, pond, bay, and all other rivers in the U.S. as well as canoe liveries and park concessions, it's likely that there are more than 10,000 canoes and kayaks underway on any given weekend day. Moreover, paddling is not restricted to weekends.

ACA Strategy to Reduce Canoe and Kayak Fatalities

Given the relatively low probability of this highly negative event, it is easy to see why many people are willing to assume this risk and do not properly wear their PFD. Moreover, if their judgment is impaired by alcohol, then the risk of a capsizing increases, but the likelihood that they are properly wearing a PFD declines. There is some evidence in these data that some of the paddlers who died and who were wearing PFDs may have been doing so in response to water conditions. This provides some evidence that paddlers do alter behaviors in response to perceived risk. However, until people fully understand the severity of the consequences of this low probability event, PFD use is likely to remain low, especially among casual and inexperienced paddlers or those using alcohol.

1 This rate is not adjusted for paddler age, experience, or any of the other many risk factors that should be taken into account. It is a crude estimate based on a questionable and probably underestimated denominator. As such, it most likely represents an upper bound on canoe and kayak fatalities, but serves to demonstrate that these are relatively low probability events, at least as viewed by the average paddler setting out on a sunny summer day on a calm lake.

ACA Strategy to Reduce Canoe and Kayak Fatalities

While paddlesport participation is increasing at an explosive rate, the educational opportunities available to paddlers have declined. The American Red Cross (ARC) discontinued its national programs in 1996 and many local chapters subsequently followed suit. Currently only a few ARC Chapters continue to offer certification as an Instructor in paddlesports. ACA, recognizing the gap left by ARC, has altered several of its educational programs but needs additional distribution to meet the national need. Furthermore, there are populations of infrequent or casual paddlers that have never been reached with any paddling related safety information.

This report, *Critical Judgment II, Understanding and Preventing Canoe and Kayak Fatalities*, comes at a most important time in the history of paddlesports and presents much-needed information on paddling-related fatalities. Based on the information in this report, ACA has developed a strategy for reducing canoe and kayak fatalities. Successfully implementing this strategy will require a significant commitment of effort and resources by ACA, other boating safety organizations, state boating agencies and USCG.

ACA, working within the greater boating safety community, has completed initial research toward developing a *Paddlesports Education and Safety Awareness National Plan of Action*. The focus of this plan will be to identify gaps in the current system of paddlesport education, instruction and information and identify methods to close those gaps.

Reaching Accident Prone Populations

Canoeing and kayaking related fatalities occur in virtually all aspects of these activities. Because of this diversity, and the diverse background of victims, no single approach or message can reach all of those who need to be reached. Using the information presented in this report on vessel manufacturer and hull materials, victim age and gender, the activity being pursued and the mistakes made, ACA will develop programs, products and partnerships that can effectively target those people at greatest risk.

There is a particular need to reach the populations of infrequent or casual paddlers that are most involved in capsizes on calm water, and who are not likely to be wearing a PFD. A significant number of these victims were using a canoe for fishing when the accident occurred. This indicates that more effort should be focused on venues and resources that are popular with casual anglers.

ACA Strategy to Reduce Canoe and Kayak Fatalities

ACA uses the information contained in this report to target its safety education efforts. To ensure success, new approaches will often need to be tested on a small scale and evaluated for effectiveness. Once deemed effective, these new approaches can be rolled out on a larger scale with confidence of having the desired impact.

Crafting Effective Messages

The same diversity that drives targeting of specific high-risk populations also drives the content of effective safety messages. Just as understanding the diversity of paddlers allows us to target specific high-risk populations, this same understanding helps ACA develop safety messages. The knowledge presented in this report about who the victims are and what mistakes they typically make is the key to crafting effective messages.

For example, a large portion of fatal capsizes result from standing or moving about in a canoe. As a result of this tragic fact, ACA and other boating safety groups need to create and disseminate information about the hazards of passenger movement and other ways to minimize capsizes. The information that needs to be effectively conveyed includes:

- Standing up or moving about in a canoe greatly increases the chance of capsizing.
- Maintain three points of contact while moving around. If you move a foot to step forward, you should be holding onto the boat with BOTH hands.
- Load the boat properly. Stay within the limits of the boat's capacity rating listed on the capacity plate (if one is present.) Keep weight centered both from side to side and bow to stern. The lower and closer the boat's load is to the centerline, generally the more stable the

boat will be assuming adequate freeboard exists.

- Keep your shoulders inside the gunwales of the boat. When retrieving something from the water, reach with your paddle or guide the boat closer to the object so you can grab the item from the water without leaning your shoulders over the gunwale.
- Take hands-on training. Paddling instruction will teach you balance, use of stabilizing strokes, and safe exit and entry on the water.

Creating effective messages involves more than knowing what information to convey. Those creating the message must understand what tone will resonate with a specific audience. For example, if one is trying to reach a young, image-conscious audience with a message encouraging PFD use, conveying the risk of drowning may not be as effective as conveying that people on the water without a PFD look silly, ignorant, or "uncool".

Just as a message with a well-crafted tone can effectively reach certain populations, carefully placed information can reach paddlecraft users whose perceived primary activity is not paddling. For instance, since anglers have been shown to be particularly at risk, and since "Big Box" discount stores sell the majority of fishing tackle in the US, safety education outreach programs should target this important venue. Since family and friends introduce many paddlers to the sport, messages that reach out to these groups should be developed.

Information from the National Survey on Recreation and the Environment (2003) provides specific information on individuals who canoe and kayak.

Canoeists

43% female, 57% male

ACA Strategy to Reduce Canoe and Kayak Fatalities

87% non-Hispanic white
 33% under 25, 77% under 45
 Incomes \$25K to \$75K
 Under 80% urban
 Favored by Northeasterners and
 Midwesterners

state, and local boating safety programs include strong partnerships with the paddlesport community at multiple levels. All survey indicators point to a rise of outdoor recreation and more demands on water resources.

Kayakers

44% female, 56% male
 85% non-Hispanic white
 60% under 35, 40% under 25

It is also important to provide in-depth and up-to-date paddlesport information and training (hands-on and classroom) created specifically

Average Participation by days vary greatly:

Activity	Average Days	1-2 days	3-10 Days	11-25 Days	25-50 Days	51+Days
Kayaking	7.7	50%	36%	8%	4%	2%
Canoeing	7.7	46%	42%	8%	3%	1%

**National Survey on Recreation and the Environment 2003 – Presentation to National Association of State Boating Law Administrators 10/03 by Dr. Gary Green*

Income – 1/3 earn less than \$25K
 85% urban
 Heavier participation in New England and Pacific Coast States

for boating safety professionals to deliver to a general land-based audience. The boating safety community of instructors should be armed with the information needed to provide basic paddlesport safety information. To this end the ACA has developed “Smart Start for Paddlers” under a Wallop-Beaux grant from the US Coast Guard. This basic safety education program is designed for use by the USCG Auxiliary, the US Power Squadrons, and states and education systems to reach entry-level as well as the broader boating public. Expanded distribution and outreach is needed for this program.

There is growth in risk activities and risk seekers:

- Of the 9.6 million participants of kayaking, 31% paddle freshwater with 20% of participation on whitewater, 31% paddle exclusively in coastal settings while 12 % paddle both fresh and coastal.
- Of the 19.6 million canoeists, 88% paddle freshwater with 15% of participation on whitewater, 6% paddle in coastal areas and 5% paddle both fresh and coastal.
- Of the 22.6 million rafters, 26% of participation is on whitewater.

Expanded Delivery of Instruction

ACA wants to ensure the widest distribution of paddlesport safety information by partnering with federal, state, and local agencies to use public resources. An initial method of producing this “multiplier effect” is to actively partner with outdoor recreation and boating safety organizations. It is imperative that the national,

Public Policy Recommendations

The knowledge presented in this report continues to point to a number of key public policy needs, ranging from increased funding for boating safety to more complete and comprehensive accident reporting. ACA proposes a comprehensive package of policy recommendations that it believes will significantly reduce the number of canoeing and kayaking related fatalities.

Accident Reporting

ACA Strategy to Reduce Canoe and Kayak Fatalities

In reviewing and analyzing accident data for this report, ACA discovered a variety of problems that hindered its ability to discern important factual information about the accidents, the vessels involved and the victims. These problems included missing or inaccurate data, difficulty accessing data and a failure to capture needed information. To correct these problems the ACA recommends

1. Increased training for state and federal marine patrol officers in paddlesport accident investigation is needed to improve the accuracy, detail, and completeness of paddlesport accident reports. Accident investigators need to be more familiar with canoeing and kayaking and the equipment used in these activities (both required and optional).

2. Continued revision and refinement of accident report forms to enable the capture of additional information critical to crafting effective safety messages for those at highest risk of being involved in a fatal canoe or kayak accident. These revisions should include:

- A. Canoes and kayaks should be documented as unique and separate types of boats. For accidents involving kayaks, the specific type of kayak involved should be identified in the accident report. Examples include: Whitewater, Touring, and Recreational.

- B. For the purpose of gathering and presenting accident information, canoes powered by outboard motors should be classified as open motorboats.

- C. A description of the safety and rescue equipment present at the time of the accident should be included in all accident reports.

- D. Those reporting an accident should include a description of any relevant supplemental flotation or watertight compartments on the craft involved.

- E. Information such as water conditions, weather conditions, and other environmental aspects bearing on the accident should also be reported in clear detail.

Funding

State and federal boating safety programs need to be adequately funded. Key to all efforts to reduce boating fatalities is the securing of a greater portion of Wallop-Breaux dollars for boating safety. ACA recommends several specific projects that should be funding priorities.

1. Funding is needed to improve the level of paddlesports knowledge among state boating officials, accident investigators and boating safety educators. To this end, funding priorities should include paddlesport-specific education efforts aimed at boating safety professionals and volunteers. Such efforts include targeted messages as well as specific safety awareness training for key leaders in key programs, delivery of classroom and on-water courses for boating safety professionals and volunteers, and partnership funding to increase paddlesports representation at boating safety meetings, conferences and educational venues.

2. A funding priority must be the development, testing and delivery of new safety messages aimed at fulfilling the safety education deficiencies identified in this report. This includes messages designed to inform all boaters of how to avoid capsize, and the need to wear a PFD in small craft. The funding should anticipate the possible need to use mass media vehicles such as billboards, TV, radio, and theater advertising. It also includes messages specifically targeted at people who occasionally use a canoe or kayak and lack basic knowledge about safely operating such craft.

3. Increased funding should be allocated for signs and other educational efforts designed to inform the public of hazards such as low-head dams and

ACA Strategy to Reduce Canoe and Kayak Fatalities

high water levels. Emphasis should be placed on the development of standard symbols for signs and marking of hazards.

4. States should increase funding for waterway law enforcement. Since law enforcement benefits the public as a whole, such funding should be allocated from general funds derived from tax revenue.

5. Federal, state, and local funding to maintain and improve the nation's stream gauge network should be increased. This is an important tool for paddlers to use to determine the risks of a given waterway on a given day.

Safety Education

The findings contained in *Critical Judgment II* point to a number of public education deficiencies that increase the likelihood of people being involved in fatal canoe and kayak accidents. The follow recommendations are designed to eliminate those deficiencies and effectively reach the people at the greatest risk of being involved in a fatal canoe or kayak accident.

1. State and federal agencies, as well as boating safety organizations, need to expand efforts to increase PFD wearage across all segments of the boating community. The effectiveness of the methods, messages, and targeting involved in these efforts needs to be evaluated using measurable benchmarks. Such efforts should draw on the methods successfully used by anti-smoking and seat belt campaigns.

2. Efforts are needed to better inform all boaters of the unique stability characteristics of small boats, including proper load and trim and how to avoid capsizes. This study reveals that anglers in particular are in great need of this information. The development and delivery of information specific to small boats should use the expertise of ACA.

ACA proposes continuation of the *National Paddlesport Education Leadership Forum*. The collective goal of the *Paddlesport Education Leadership Forum* is to minimize the loss of life and personal injury of paddlesport participants through preventive means and to maximize safe use and enjoyment of the US waterways by the paddling public.

ACA proposes enhanced efforts targeted at the entry-level or casual paddler, including but not limited to

- Increased training and education materials for paddlesport rental and livery operations.
 - Commercial operators tend to be highly professional and take risk management very seriously. When a commercial operator is provided with effective materials to manage risk, the materials are generally used to great effect.
 - Rental customers are frequently part of large groups providing an excellent opportunity to provide controlled “peer pressure” on participants.
- Increased training and education materials for school systems and recreation programs.
 - Programs packaged for family and group participation should be developed and introduced.

ACA proposes a research project to evaluate the effectiveness of information presented to paddlesport participants in a camp, rental or instructional program. This survey could be used to determine *Paddlesport Safety Best Practices* for program providers.

On a final note, the ACA will continue to monitor and report on fatal accidents involving paddlesports and will work to remain proactive in matters of safety education and public policy. A central theme of the American Canoe Association is “making the world a better place

References

National Survey on Recreation and the Environment (NSRE) 2000-2003. The Interagency National Survey Consortium, Coordinated by the USDA Forest Service, Recreation, Wilderness, and Demographics Trends Research Group, Athens GA and the Human Dimensions Research Laboratory, University of Tennessee, Knoxville, TN.

United States Coast Guard (USCG), Boating Accident Report Database (BARD) 1996-2002.

Newman, L.M. Dickema, D.S. Shubkin, C.D. Klein, E.J., Quan, L. (1998) Pediatric Wilderness Recreation Deaths in Western Washington. *Annals of Emergency Medicine*. 32(6):687-92.

Quan, L, Bennett, E, Cummings, P, Trusty, M.N., and Treser, C.D. (1998) Are life vests worn? A multiregional observational study of personal flotation devices use in small boats. *Injury Prevention*. 4(3):203-5.

Rosenbaum, P.R. & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1): 41-55.

Rosenbaum, P. R. & Rubin, D. B. (1984). Reducing bias in observational studies using subclassification on the propensity score. *Journal of the American Statistical Association*, 79(387), 516-24.

Smith, G.S. and Howland, J. (1999) Declines in Drowning: Exploring the Epidemiology of Favorable Trends. *Journal of the American Medical Association*. 281(23): 2245-6.
Smith, G.S. (2001) Private Communication

Wittman, L. (2000) Kayaking is safer than you might think (really!). *American Whitewater*, September/October, 100-1.

Dr. James McKnight, Marine Safety Foundation, Human Errors in Boating Safety email

ACA Programs and Resources

The American Canoe Association national Instruction program has been a driving force in paddlesport education for more than 30 years. In 1929 prior to the establishment of its own instructor certification program, the ACA was instrumental with the development of a standardized paddlesport nomenclature in conjunction with the American Red Cross, Boy Scouts of America and Girl Scouts of the USA.

Today, the ACA has a host of available courses covering many different craft and environments. ACA courses range from basic skills workshops to Instructor Certification courses. "Quickstart" orientation courses may be as short as 3 hours while more advanced Instructor workshops may run to 60 contact hours of instruction.

Courses are available within:

- **Touring Canoe** – designed for flatwater environments such as ponds and lakes
- **River Canoe**-designed for moving waters and whitewater to Class III-IV
- **River Kayak**-designed for moving waters and whitewater to Class III-IV
- **Coastal Kayak**-designed for tidal marsh areas and coastal areas with surf up to 1 mile from shore in specific wind conditions. This would appear to be the most popular area of programming for 2002 and 2003.
- **Swiftwater Rescue**-designed for the whitewater paddler and/or rescue personnel who may be called to assist in an entrapment or rescue situation.

ACA PROGRAMS & RESOURCES

- **Surf Kayak**- a specialize type of paddling which occurs in the coastal surf zone using whitewater type craft
- **Rafting**-ACA's rafting program is centered on the personal or family raft
- **Adaptive Paddling** courses are available across most craft in order to facilitate Instructor's ability to modify programs for those requiring adaptations due to injury or disability.
- **Operation Paddle Safe**- designed for individuals who need documentation of exposure to safe paddling practices but not instructor certification.
- **SmartStart for Paddlers**- a 20 minute safety orientation targeting newcomers to paddlesport.

ACA has produced a series of safety material including:

SmartStart for Paddlers is a 20 minute orientation for the newcomer to paddlesport. It is available through local boating programs from the US Power Squadrons, US Coast Guard Auxiliary and ACA.

National Livery Safety System is a series of canoeing 3 tapes (2 general public, 1 staff training), a risk management manual and livery posters designed to be used in commercial livery/ rental facilities to expose staff and the paddling public to safe paddling practices.

National Paddlesport Safety System is a series of three tapes including Whitewater Rafting, Whitewater Kayaking and the award winning Coastal Kayaking. These tapes, also designed for use in livery/rental facilities increase the breath of safety materials available to the rental customer.

Quickstart Your Canoe/Quickstart Your Kayak Videos are produced to offer safety education to the new paddler. This is our latest video series and has been widely distributed since its release in 2003.

Know Your Limits- an 8 page glossy pamphlet designed to convey very elementary concepts in paddlesport safety across the widest possible audience.

ACA Website: See additional information on-line at www.acanet.org

The **International Scale of River Rating Difficulty** is a guide for assessing the difficulty of a stretch of water. Some rivers will not clearly fall into a neat system. Temperatures below 50 °F should change a rating to be one class more difficult than normal.

Class I Moving water with few riffles and small waves. Few or no obstructions.

Class II Easy rapids with waves up to three feet and wide clear channels that are obvious.

Class III Rapids with high, irregular waves often capable of swamping an open canoe. Narrow passages that often require complex maneuvering. May require some scouting from shore.

Class IV Long, difficult rapids and constricted passages that often require precise maneuvering in very turbulent waters. Scout from shore often necessary and conditions make rescue difficult. Canoeists and kayakers should have the ability to roll.

Class V Extremely difficult. Long very violent rapids with highly congested routes that nearly always must be scouted. Rescue conditions are difficult and there is a significant hazard to life in the event of a mishap. Ability to execute a roll is essential for all boaters in kayaks and closed canoes.

Class VI Difficulties in Class V carried to the extreme of navigability. Nearly impossible and very dangerous. for experts only.

Source: American Whitewater

GLOSSARY

Blade: The broad part at the ends of the paddle.

Bow: The forward end of the boat.

Bracing: A paddle placement resisting capsizing.

Cockpit: The enclosed central compartment on a kayak, in which the paddler sits.

Deck: The top part of a kayak that keeps the hull from filling with water.

Difficulty Rating: The rating of a river section's navigability.

Drop: A steep sudden slope in a river. Often called a rapid.

Eddy: The area behind an obstruction in current with still water or upstream current.

Eddy Line: the line which separates the eddy from the main current.

Falls: Drops where water falls free.

Ferry: Maneuver in which a paddler uses the force of the water to move the kayak sideways across the current.

Flatwater: Lake or river water without rapids.

Flotation: Waterproof compartments, foam blocks, or inflatable airbags. This flotation will help a swamped boat stay on the surface, making rescue easier.

Gunwales, also "gunnels": The rails along the top edge of a canoe's hull.

Hull: The structural body of the boat, the shape of which determines how the boat will perform in various conditions.

Hydraulic: Turbulence caused by water flowing over an obstacle.

Hypothermia: Physical condition that occurs when the body loses heat faster than it can produce it.

Keeper: A hydraulic that holds objects in recirculating water.

Rapids: River section with steep fast flow around obstructions.

Rocker: The amount of curvature of a line down the middle of a kayak's hull, from bow to stern. More rocker (more curvature) usually makes a boat more maneuverable. Less rocker tends to help the boat track in a straight line.

Roll: The technique of righting a capsized paddlecraft with the paddler remaining in the paddling position.

Sit-on-top: kayaks without a cockpit, sit-on-tops are usually self-bailing with various seat and foot brace configurations. Many are for recreational use, but some are designed for touring or racing.

Slack Water: Water flowing without riffles or rapids.

Spray Skirt (Spray Deck): A neoprene or nylon skirt worn by a kayaker that attaches to the rim (coaming) of the cockpit. It keeps water out of the kayak.

Stern: the rear end of the boat.

Strainer: An obstruction in moving water, which allows water to pass through but stops and holds objects such as boats and people. Fallen trees often form strainers in current.

Throw bag: A nylon bag filled with rope (which floats) that is thrown to rescue or assist swimmers.

Undercut Rocks: "undercuts" are rocks with water flowing under them, forming a trapping hazard.

Wet exit: Coming out of a capsized kayak or canoe.

Whitewater: Aerated rapids.



This project made possible through support provided by the National Safe Boating Council.
NSBC Mission: To enhance the safety of the recreational boating experience through education and outreach.

For additional information on boating safety visit
www.acanet.org
www.safeboatingcouncil.org