## NASBLA Engineering, Reporting & Analysis Committee
## Accident Reporting & Analysis Subcommittee

# Paddlesport Accident Training Module (Revised)

### Charge 2:

Based on the current content of accident investigation reporting and assessments of possible data gaps, review the "Paddlesports Accident Training Module" that was developed and proposed by the **2007 Paddlesports Committee** to supplement accident investigators' knowledge of paddlesport issues. Expand the review of data to include a range of high-risk vessel types, consider elements lacking in investigator reporting, and determine what content or other changes would need to be made to the 2007 product to make it course-ready. (Follow-up on and possible expansion of vessel types covered in the 2007 charge product)

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In May 2008, this Module was presented to the NASBLA Executive Board as part of the materials for the joint meeting of the Board and the NASBLA Committee Chairs. At that time, the Subcommittee included a preliminary recommendation that the Module document (in the pages that follow): 1) be passed in its entirety to **NASBLA's Training & Certification Subcommittee** for lesson plan and PowerPoint development; 2) that it be given consideration as a separate, standalone PowerPoint course; 3) that it replace the current four-page piece included in the appendix of the student manual (Level 1 – Comprehensive Manual); and 4) that a "suggested" supplemental report form be developed to accompany the Module, such that an accident investigator could use to capture the additional information.

The revised Module and supplemental form (Issues for Consideration) is the result of: 1) incorporation of primary resource materials (on cold water survival) and edits identified by Jeff Johnson; 2) further review and format modifications provided by Gary Haupt and Jim Getz (i.e., to make the module more appropriate for inclusion in the accident manual); and 3) development and inclusion of the "supplemental reporting form" – shown in this document on pages 21-22 under the title "Investigating Paddlesports Accidents: Issues for Consideration." On that latter item, Haupt and Getz noted that they did not include blank fields for documenting information, but rather thought that it more appropriate for this piece to be presented as a synopsis of pertinent issues for an investigator to consider when conducting a paddlesport accident.

# PADDLESPORT ACCIDENT TRAINING MODULE

**Introduction:**

This training module came about in response to the growing number of paddlesport enthusiasts nationally, and the corresponding potential for an increase in paddlesport accidents. It is believed that many paddlesport accidents go unreported unless there is a fatal or near fatal outcome. Therefore, it is important for the investigator to have some background knowledge of paddlesports and correct terminology when/if they are conducting an investigation of a paddlesport accident. This module is intended to supplement the knowledge of the already-trained investigator of boating accidents with knowledge specifically addressing paddlesport issues, and the need to collect information critical to understanding and preventing further paddlesport fatalities. It is not intended as a “How to Paddle” course.

This module is broken down into:

1. Basic Terminology/Definitions for Paddlesports
2. Types of boats
3. Class of water
4. Flotation Equipment
5. Impact Analysis
6. Essential Equipment (i.e. spray skirt, paddle, helmet, PFD, etc)
7. Weather/Environment Factors
8. Water Hazards
9. Accident Statistics
10. Cold water immersion/hypothermia
11. Human Errors
12. Summary

**Synopsis:**

Many paddlesport accidents can be attributed to choosing the wrong type of equipment for the activity intended. For example, a recreational kayak with a large cockpit with no spray skirt and no bulkheads or flotation may be a fine choice for calm or flat waters, but may prove dangerous in whitewater or coastal waters. This type of information is pertinent to the investigation but may be overlooked even by seasoned investigators unfamiliar with the characteristics of different styles of paddleboats and their suitability for various activities. This module will help investigators judge whether the choice of equipment contributed to an incident.

Injuries and fatalities from paddlesport accidents are commonly associated with capsize or falls overboard. Overloading the boat or having an unbalanced load can contribute to capsize, and the smaller the boat, the easier it is to overload. But the investigator will not be able to determine how the boat was loaded once it has overturned. Investigators

should explore this issue in questioning if possible. Moving around in a small boat can also cause capsize or a falls overboard if not done properly. Investigators should consider what the victim was doing immediately prior to the accident: standing in the boat, reaching over the gunnels, etc.

Water conditions also contribute to many paddlesport accidents. A river that is easy for novice paddlers to negotiate may become hazardous when flows are high after a storm or a dam release. Very low flow of water can be as hazardous as very high water flows, especially in drop-pool type rivers. Rainfall miles away may increase the strength of a normally mild current. Investigators need to consider not only the weather at the time of the accident, but prior weather conditions that may have increased the difficulty of the outing. Another key consideration is the ability of the paddler; inexperienced paddlers may be unaware of the hazards they will encounter, while more experienced paddlers may challenge themselves beyond their capabilities.

In many paddlesports accidents there is a lack of the traditional physical evidence that is present in many boating fatalities. The investigator of a paddlesports accident will have to utilize interview skills to a great extent, and will need to interview all witnesses and paddling companions. In the event of a fatality the investigator may also need to do follow-up interviews with the next of kin of the victim.

**1. Basic Terminology/Definitions relating to Paddlesports for investigators:**

***Asymmetrical:*** Pertaining to a hull shape in which the widest point is aft or forward of amidships.
***Bang Plate (or Nose/Tail Cone):*** A reinforcing plate or “shoe” made of abrasion resistant material that protects the stems of a kayak or canoe from scrapes and impact damage during beaching or launching.
***Blade:*** The wide, flat area of a paddle.
***Broaches:*** Getting pinned on a rock, either amidship, or at the ends. Likely around sharp rocks that can crease a boat or serve as a point to be wrapped by the boat.
***Bulkhead:*** Transverse wall that creates a sealed compartment fore or aft in a kayak. Primarily used for flotation but also used as storage with access via deck hatches.
***CFS*** - Cubic feet per second, a measurement of the volume of water flowing down a river.
***Coaming:*** The rim of a kayak’s cockpit, which has a raised lip to which a sprayskirt can be attached.
***Current:*** Three dimensional flow of the water needs to be considered. Current is NOT just Horizontal.
***Current rips:*** Small waves formed on the surface by the meeting of opposing currents.
***Draw stroke:*** A stroke that is used to move a canoe or kayak sideways.
***Dry bag:*** Waterproof storage bag.
***Ebb:*** A receding or falling tide.
***Eddy:*** Area of swirling water down-current of an obstruction.
***Eddy line:*** Transitional area between main current and eddy current.

***Entanglement:*** Getting tangled exiting the boat. Usually caused by ropes and loose lines. Swimmers from boats can also become entangled in low hanging trees when trying to escape the current.
***Eskimo roll:*** A self-rescue technique used to right an overturned kayak or canoe without exiting the boat.
***Foot Entrapment:*** Having a foot get entrapped by rocks on the bottom of a river. Caused by trying to stand while being swept downstream in water *usually* mid-thigh to mid-torso deep.
***Grab loop:*** Short rope or grab-handle threaded through bow or stern stem of a kayak or canoe.
***Hatch:*** Deck access opening.
***Hydraulics:*** A condition in which water is flowing over an obstruction and a backwash is created.
***Initial stability:*** A boat's resistance to leaning.
***Kneeling Pad (canoe):*** A pad, usually made of waterproof foam, which canoeists use to cushion their knees while paddling.
***Low Head Dam:*** Can be manmade or natural. The top of the dam is below the water's surface, making it difficult to see until the paddler is only a few yards out.
***Paddle Leash (kayak):*** A rope or line, sometimes elastic, that attaches to both the paddle and the boat so the paddle won't be lost if dropped in the water.
***Paddle Float (kayak):*** A floating cushion either inflatable or made of foam, that slips onto a paddle blade and turns the paddle into a temporary outrigger. (Often used in self rescue)
***Peel out:*** The act of leaving an eddy and entering the main current.
***Portage:*** The act of carrying the boat and supplies to the water, from the water, or around obstacles in the water.
***Put in:*** The starting place of a paddling trip.
***Rocker:*** Refers to the amount of lift at the each end of the craft. The more the craft curves up at its ends, the easier it is to turn, but the more difficult to paddle in a straight line.
***Secondary stability:*** A hull's tendency to stabilize as it leans to one side.
***Shaft:*** The rod or tube holding the blades of the paddle.
***Sprayskirt (kayak):*** A stretch of water resistant fabric, usually nylon or neoprene, that attaches both around the paddler's waist and the kayak cockpit and keeps water out of the boat.
***Spraycover (canoe) aka 'Spraydeck':*** A stretch of water resistant fabric, usually nylon or neoprene, that attaches around the paddler's waist and the canoe's outer hull and keeps water out of the boat.
***Strainers:*** Trees or sometimes single branches in the current with water flowing through, causing a **severe** pinning hazard.
***Take out:*** The end point of a paddling trip.
***Tandem:*** Two person kayak.
***Thwart:*** A support structure that stretches across the width of a canoe.
***Thwart Bag (canoe):*** An easily accessible bag that attaches to a thwart for storing frequently used gear.

***Undercut Rocks:*** Undercuts are a water feature where a slab of rock, or rock shape, forces the current flow to go under the surface.
***Vertical Pin:*** This occurs when the bow or stern buries and gets pinned on the bottom after a steep drop.

**2. Types of boats:**

**Kayak** - A watercraft designed to be manually propelled, typically without provision for auxiliary power, with the occupant intended to be seated with legs approximately 90° from the torso.

Kayaks can generally be broken down into four main categories of boats -- Whitewater, Touring, Recreational, and Sit on Top. These are the four major groups, but there are many boats that fit in between these categories. And with the increasing popularity of kayaks there is a great deal of research and development being done regarding new models, materials, and special purpose boats.

Many kayaks are constructed of rotomolded plastic with higher end boats often being constructed of materials such as fiberglass, Kevlar, carbon fiber or wood. There are also popular models with folding frames covered by fabric and inflatable kayaks. The regulatory agency's accident report form may ask for the composition of the hull.

***A. White-water Kayak:*** The whitewater boat is typically a shorter more maneuverable craft for use on whitewater. The whitewater boat normally tracks poorly on flatwater lakes and streams.

***B. Recreational Kayak:*** A kayak that typically has a large cockpit with or without a provision for sealing the opening to the body of the occupant (i.e. spray-skirt)***.*** A recreational kayak is designed for the more casual paddler and is best suited for flat-water lakes and streams. The recreational boat is normally less than 12 feet in length and has a wider beam and larger cockpit. The larger cockpit allows easier access and egress and better cooling in warmer climates, but is also more difficult to seal with a spray-skirt.

The characteristics that make a recreational boat well suited for a casual paddle on a flat-water lake or stream also make it a poor choice for sea kayaking and/or white water. The larger cockpit makes for a vessel that takes on water more easily than boats with smaller cockpits. The recreational boats often do not have

**Recreational Kayak**

watertight bulkheads or extra flotation. (Extra after market inflatable flotation bags can be added and the investigator of a kayaking incident should check for the added flotation)

***C. Touring Kayak:*** A boat that typically has built in storage capacity for gear, and a provision for sealing the cockpit opening to the body of the occupant with a water-tight spray-skirt. These boats are normally longer and more slender in construction. They track well and glide through the water better than the broader of beam recreational boats, but are not as stable. They also have a tighter cockpit area and with a spray-skirt shed water well. Often used in coastal waters and also perform well on rivers without white water.

***D. Sit-On-Top:*** A kayak that typically has a sealed, watertight deck surface into which seats and features are molded. A sit-on-top kayak typically does not have an opening that can be sealed around the occupant. While considered a beginner boat, not all of them are. Sit-on-tops outfitted with knee straps allow a person to control the boat better and perform advanced maneuvers. A “surf Ski” is a type of sit-on-top used by advanced paddlers. (Some literature categorizes the sit-on-top kayak as a recreational kayak)

**Sit-on-Top Kayak**

**Canoe**- A watercraft, designed to be manually propelled, with or without provision for auxiliary power, with neither end having a transverse dimension greater than 45 percent of its maximum beam and conforming to the following table:

| Canoe Length | Maximum Beam |
|---|---|
| 14 ft or less | 1/3 Canoe Length |
| >14-16ft | 1/4 Canoe Length |
| >16 ft | 1/5 Canoe Length |


***A. Whitewater Canoe:*** A canoe designed for whitewater will have more rocker and more flotation than its flatwater counterpart.

***B. Recreational Canoe:*** A general use canoe, usually built for two occupants (tandem).


Commonly between 15 and 18 feet in length. The type of canoe generally available for rental at a canoe livery, this boat is stable but not fast.

***C. Touring Canoe:*** Long and more slender than canoes built for day trips, touring canoes are built for speed. They come in solo and tandem versions, and do best on calm waters.

**Touring Canoe**

***D. Decked Canoe:*** These canoes resemble a kayak in that they have a closed deck, but the paddler kneels in them and uses a canoe paddle. They come in solo and tandem versions. They can be shorter for whitewater use or longer for touring.

***E. Inflatable Canoe or Kayak-*** Any canoe or kayak that achieves and maintains its intended structure, shape, and buoyancy through the medium of inflation.

**Inflatable Kayak**

## 3. Class of water

### International Scale of River Difficulty

This is the American version of a rating system used to compare river difficulty throughout the world. This system is not exact; rivers do not always fit easily into one category, and regional or individual interpretations may cause misunderstandings. It is no substitute for a guidebook or accurate first-hand descriptions of a run. Paddlers attempting difficult runs in an unfamiliar area should act cautiously until they get a feel for the way the scale is interpreted locally. River difficulty may change each year due to fluctuations in water level, downed trees, recent floods, geological disturbances, or bad weather. As river difficulty increases, the danger to swimming paddlers becomes more severe. As rapids become longer and more continuous, the challenge increases. There is a difference between running an occasional class-IV rapid and dealing with an entire river of this category. Paddlers should allow an extra margin of safety between skills and river ratings when the water is cold or if the river itself is remote and inaccessible. A river rating should take into account many factors including the difficulty of individual rapids, remoteness, hazards, etc.

### The Six Classes of Difficulty:

### Class I Rapids

Fast moving water with riffles and small waves. Few obstructions, all obvious and easily missed with little training. Risk to swimmers is slight; self-rescue is easy.

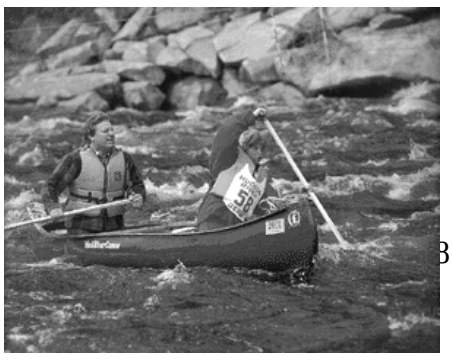
### Class II Rapids: Novice

Straightforward rapids with wide, clear channels which are evident without scouting. Occasional maneuvering may be required, but rocks and medium-sized waves are easily missed by trained paddlers. Swimmers are seldom injured and group assistance, while helpful, is seldom needed. Rapids that are at the upper end of this difficulty range are designated “Class II+”.

### Class III: Intermediate

Rapids with moderate, irregular waves which may be difficult to avoid and which can swamp an open canoe. Complex maneuvers in fast current and good boat control in tight passages or around ledges are often required; large waves or strainers may be present but are easily avoided. Strong eddies and powerful current effects can be found, particularly on large-volume rivers. Scouting is advisable for inexperienced parties. Injuries while swimming are rare; self-rescue is usually easy but group assistance may be required to avoid long swims.

**Good boat control in tight passages and around ledges is required.**



**Class IV: Advanced**

Intense, powerful but predictable rapids requiring precise boat handling in turbulent water. Depending on the character of the river, it may feature large, unavoidable waves and holes or constricted passages demanding fast maneuvers under pressure. A fast, reliable eddy turn may be needed to initiate maneuvers, scout rapids, or rest. Rapids may require “must” moves above dangerous hazards. Scouting may be necessary the first time down. Risk of injury to swimmers is moderate to high, and water conditions may make self-rescue difficult. Group assistance for rescue is often essential but requires practiced skills. A strong Eskimo roll is highly recommended. Rapids that are at the lower or upper end of this difficulty range are designated “Class IV-” or “Class IV+” respectively.

**Class V: Expert**

Extremely long, obstructed, or very violent rapids which expose a paddler to added risk. Drops may contain large, unavoidable waves and holes or steep, congested chutes with complex, demanding routes. Rapids may continue for long distances between pools, demanding a high level of fitness. What eddies exist may be small, turbulent, or difficult to reach. At the high end of the scale, several of these factors may be combined. Scouting is recommended but may be difficult. Swims are dangerous, and rescue is often difficult even for experts. A very reliable Eskimo roll, proper equipment, extensive experience, and practiced rescue skills are essential.

Because of the large range of difficulty that exists beyond Class IV, Class 5 is an open-ended, multiple-level scale designated by class 5.0, 5.1, 5.2, etc. Each of these levels is an order of magnitude more difficult than the last. Example: increasing difficulty from Class 5.0 to Class 5.1 is a similar order of magnitude as increasing from Class IV to Class 5.0.

**Class VI: Extreme and Exploratory Rapids**

These runs have almost never been attempted and often exemplify the extremes of difficulty, unpredictability and danger. The consequences of errors are very severe and rescue may be impossible. For teams of experts only, at favorable water levels, after close personal inspection and taking all precautions. After a Class VI rapids has been run many times, its rating may be changed to an appropriate Class 5.x rating.

Also, see Appendix A for a Wave Height Chart.

**4. Flotation Equipment**

The American Boat and Yacht Council (ABYC), which develops safety standards for the manufacturers of recreational boats, recommends that flotation be provided to keep the canoe or kayak from completely submerging when it is filled with water and passengers are clinging to it and flotation be included to compensate for the engine/motor's and

battery's swamped weight, if so equipped. The amount of flotation is calculated per ABYC H-29.7.

ABYC further recommends that capacity information be permanently displayed and include if the vessel is intended for mechanical propulsion (OR if rated for mechanical propulsion, the maximum power rating be so marked in HP or Kw on the capacity label. The label should also include maximum weight capacity (persons, engine/motor, and gear) in pounds (kg) and, if a touring kayak, add "with watertight spray skirt" and maximum persons capacity in pounds (kg).

In the matter of canoes and kayaks ABYC's standards are voluntary. Extra after market inflatable flotation can be added and the investigator of a paddling incident should check for the added flotation.

**5. Impact Analysis**

This examination will be the same as for any boat accident, and is well covered in the *National Boating Accident Investigation Field Guide*; however, an investigator should be aware that in the event of a single vessel paddlesport fatality where the victim drowns there may be no discernible evidence of impact, and unlike many powerboats most well used canoes and kayaks have some easily seen scuffs and scrapes. From an evidence-gathering standpoint, the plus side of the canoe/kayak investigation is that usually the entire vessel can be transported to a lab for examination. As with all law enforcement investigations, care should be taken to insure that warrants are obtained when appropriate.

**6. Essential Equipment**

Investigators of powerboat accidents will be familiar with *required* equipment covered by carriage requirements in federal regulations. Only a few of these requirements apply to paddleboats, as outlined below. However, various safety equipment can be considered *essential* given that it is common for paddlers to end up in the water. The more experienced and safety conscious paddler will generally have more safety equipment, and will *wear* an approved PFD at all times. Type III and V life jackets are most appropriate for paddling; the label should always be checked for suitability for the intended activity. The essential equipment list will depend upon:

- The paddling activity: i.e., whitewater kayaking, sea kayaking, inland lake canoeing, fishing
- The surroundings: i.e., a remote wilderness vs. a popular state park
- Water conditions: river classification, high or low flow, tides, wave height
- Water temperature
- Local hazards or obstructions
- Duration of the journey
- Weather

- Availability of emergency assistance

**Federally Mandated Gear for Paddleboats**

- Approved PFD for each person (Check state regulations for wear requirements)
- Sound producing device (Usually a whistle-normally attached by lanyard to PFD)
- Visual Distress Signals (Required if expecting to be out at night and during the day in some coastal areas)
- All round white light for operation at night (Flashlights are acceptable)

**The experienced paddler wears a PFD.**
**Type III PFDs are good for paddling.**

**Proper Clothing for weather**
- (Watersport clothing is designed to reduce heat loss, and paddlers should always dress for water temperature.)
- Water shoes or sandals (without velcro which may contribute to entanglement)
- Shirt/shorts/pants of appropriate weight and material to provide insulation and control evaporation.
- Water/wind proof jacket and pants
- Hat-for sun, rain, warmth
- Change of clothing in dry bag

**For cold water/weather, add:**

- Dry suit or wetsuit (wetsuit when water is not warm enough for swimming, drysuit when exposed to cold condition for lengthy periods)
- Neoprene boots and gloves
- Pogies (hand protectors)
- Balaclava or polar fleece cap
- Fleece or woolen shirt

**Recommended Gear for Self-Rescue:**

- Paddle Float (stored in easy reach on bow)
- Float Bags (for additional flotation, made for canoes and kayaks)
- Hand Bilge Pump, or Bailer
- First Aid Kit

**Reboarding with help of a paddle float**

**Additional Safety Gear**

Compass and/or Global Positioning System (GPS)
Cell phone
VHF or weather radio
Marine chart and ruler
Tide table
Distress flares
Air Horn
White Strobe light
Radar reflectors
Signal mirror
Binoculars
Duct tape (for field expedient repairs)
Mylar survival blanket
Helmet (for rough waters and white water paddling)
Poles for maneuvering canoes upstream when too shallow to paddle
Extra lines-to allow for maneuvering a canoe through stretches where the paddler cannot or does not want to paddle

**Optional Equipment (for a day outing on lakes and rivers)**

Tow-line (for flatwater and sea kayaking primarily)
Throw bag with floating line (for use in whitewater and river primarily)
Paddle leash
Spare take-apart paddle
Spray skirt
Maps
Large Sponge
Knife (attached to PFD)
Waterproof flashlight
Gloves for blister protection


**Spray Skirt**

## 7. Weather/Environmental Factors:

Paddlers are generally more at the mercy of the weather than are many other boaters.

They should always check weather before starting a paddling trip. The paddler who gets in trouble when weather moves in as predicted is a sign of an inexperienced paddler to the investigator. Paddlers are generally closer to the water than are power boaters so water temperature is always a factor. Experienced paddlers consider getting wet either possible or very likely, and equip themselves appropriately before venturing forth. The paddler is also generally more exposed to the elements than other boaters so the investigator should consider air temperature as a possible contributor also.

***The investigator of a paddlesport accident should record:***

- Wind direction and speed
- Any factors affecting visibility
- Water and air temperature
- Depth, width, velocity and cubic feet per second (CFS) of the river
- Strength and direction of current
- If the water on which the incident occurred is tidally affected, the stage of the tide should be recorded.

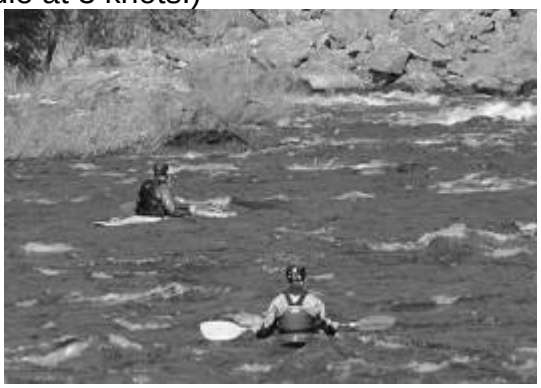
***Other issues for the investigator to consider:***

-Paddling against wind especially above 10 or more knots can be very tiring for a paddler.

- Paddling against a 2 knot current can make forward progress slow. (Sea kayakers normally use a rule of thumb that they can paddle at 3 knots.)
- Weather effects can be very localized and seasonal.
- A wind blowing with the current can magnify the effort needed to make forward progress.
- A wind blowing against the current can create significant chop.
- Tides are affected by phases of the moon, atmospheric pressure, wind, and rains. Tides and currents can have areas of localized effects resulting from narrowing of a channel, bridge embankments, changes in water depth, and other factors.

-The amount of humidity in the air can affect paddler performance.

-Existence of whirlpools



**Wind blowing against the current can create significant chop.**

**8. Water Hazards**

***<u>Environmental conditions</u> to consider that may have contributed to the accident. It is helpful to not only document water conditions at the time of the accident, but also the potential cause of changes to those conditions that may/may not have been anticipated:***

- Hazardous water conditions caused by:
  - Storms/strong winds
  - Recent heavy rainfall
  - Melting runoff
  - Dam water releases
  - Tidal currents
  - Riptides-strong but narrow currents that push away from shore, formed especially around storm events.
  - Tide rips-turbulence caused by currents that flow across each other in a river or a sea.

High water flows from weather events often create natural and man-made hazards that may not normally be present. Low water can also be a hazard due to the tendency for paddlers to get out of the boat and step in "holes" where feet can become entrapped. The height of a river is directly related to the flow of the river in cubic feet per seconds (CFS). For some rivers, the U.S. Geological Survey maintains gauges which measure CFS; readings are available at: http://waterdata.usgs.gov/oh/nwis/rt.

The capacity (volume) of the river at any point can be calculated by multiplying the depth by the width by the velocity. If the CFS is known, you can calculate the velocity with the formula:

Velocity = CFS ÷ (width x depth)

Because CFS remains constant, this formula will allow you to calculate velocity at different points in the river, taking into account narrower passages. It is important to know velocity because the force of water obeys a square law: the force of the water goes up four times when water speed is 2 miles per hour, nine times when water speed is three miles per hour and so on.

Waves that are unremarkable to larger boats can be significant to a sea kayak or other paddleboat. Investigators should refer to the U.S. Coast Guard's Beaufort Wind Scale, which equates wave height to wind speed.

The natural configuration of the river or naturally occurring entrapments may be responsible for an accident and may be the location site of a body.

**Natural configurations occurring in rivers at the location of an accident that an Investigator should be aware of:**


Strainer

***Strainers:*** Trees or sometimes single branches in the current with water flowing through, causing a **severe** pinning hazard. Strainers are caused by erosion. Trees fall because of old age, storms, and floods. Look for strainers on wooded riverbanks, along small creeks after high water. They are often found on the outside of a bend, and on less frequented rivers. Their presence can sometimes be detected by using downstream vision to spot bobbing twigs and/or irregular flow patterns. Strainers can shift after an accident so the investigator should look downstream if a strainer is not obvious at the site of the accident. Also an entire tree trunk can be a dangerous obstacle because a boat braced against it broadside can be swept under and kept under by unseen branches below.

***Undercut Rocks:*** Undercuts are a water feature where a slab of rock, or rock shape, forces the current flow to go under the surface. They can sometimes be spotted by a dark shadow on the upstream side of a rock, the lack of pillowing action by oncoming water, and by the lack of a predictable eddy on the downstream side. (Most undercuts are well known by locals and are sometimes even listed in guidebooks; therefore, a paddler who becomes caught in one may be inexperienced on the particular stretch of water, or inexperienced in general)

***Manmade Entrapments:*** Anything manmade in a river can be dangerous; this includes bridge pilings, low head dams, junked cars, and assorted other manmade junk commonly found in urban river ways, under highway crossings, and at abandoned dam sites.

***Foot Entrapment:*** Having a foot get entrapped by rocks on the bottom of a river. Caused by trying to stand while being swept downstream in water *usually* mid-thigh to mid-torso deep.
Prevention: stay in safe swimmer's position (on back, feet up and pointed downstream) unless the water is less than knee deep.

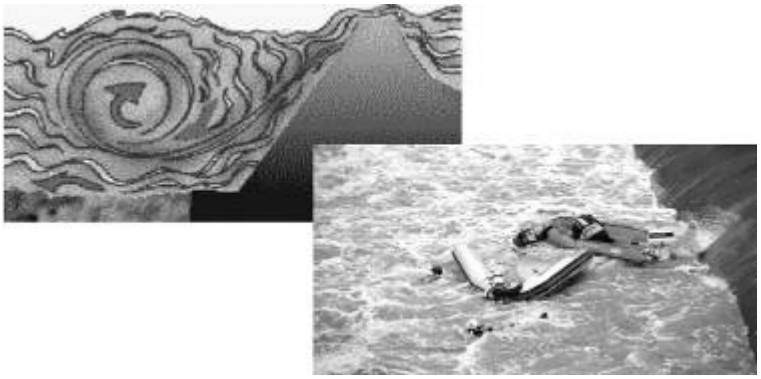
***Broaches:*** Getting pinned on a rock, either amidship, or at the ends. Likely around sharp rocks that can crease a boat or serve as a point to be wrapped by the boat.

***Entanglement:*** Getting tangled exiting the boat. Usually caused by ropes and loose lines. Prevention: boater should practice wet exits and critically evaluate rigging for entanglement potential. Experienced paddlers will keep throw ropes neatly bagged and carry a knife for rescue.

***Vertical Pin:*** This occurs when the bow buries and gets pinned on the bottom after a steep drop. A concern in water that drops over 3-4 feet. Can be prevented with adequate scouting and leaning back into a “boof” move to keep the bow up.

***Hydraulics:*** A condition in which water is flowing over an obstruction and a backwash is created. The most dangerous hydraulics are those that have an evenly formed backwash (for four or more feet). Dams and hydraulics that are very regular and perpendicular to the current are the most dangerous. (Sometimes known as a “drowning machine”)

***Low Head Dam:*** Can be manmade or natural. This type of hazard may not be visible until the paddler is only a few yards out. May be invisible during some water conditions, and a death trap during others. May range from 25 feet drop-off to 6 inch drop-off. The characteristics of moving water are the same regardless of dam size. Even a moderate flow of water can be deadly. Danger of not only going over the dam, but in getting trapped in the recirculating current formed below the dam. This hazard can normally be detected by proper scouting, and watching for a smooth horizon line.



**9. Accident Statistics**

Most non-fatal paddlesports accidents rarely meet reporting thresholds; therefore if an officer is called upon to investigate a paddlesports accident, it is likely that it will be a fatal or near fatal incident.

Serious paddlesports accidents often involve falls overboard and/or capsizing. These are most often caused by occupant movement/weight shift. It is often the fall overboard that causes the capsize. Another potential cause is an overloaded boat or an unbalanced load.

Much of the material in this course seeks to make the investigator more knowledgeable about conditions that may have caused a paddlesport accident so that accurate, detailed and complete accident reports may be generated. Such information is critical to determining true causation, thus allowing the paddlesport community to determine education and training needs for paddlers to prevent paddlesport accidents and reduce fatalities.

## 10. Cold water Immersion-Hypothermia

All boaters need to be familiar with the risks of hypothermia and cold-water immersion, take necessary precautions, and know treatment protocol. This is particularly true for paddlers, whose boating activities are more likely to result in a swim. Paddlers can suffer hypothermia without getting wet if the air temperature is cold and they have not dressed for the weather. This will occur over a longer period of time, however, than hypothermia induced by cold-water immersion, since cold water can rob the body of heat up to 25 times faster than does air of the same temperature. The heat loss is exacerbated by exertion. Paddlers must know and dress for both air and water temperatures.

Cold water is considered to be water below 70 degrees, though the body will eventually lose heat in any water colder than body temperature. There are four stages of cold-water immersion:

***Cold shock –*** Sudden immersion can cause immediate, involuntary gasping, which can lead to water inhalation and death. Other symptoms which can manifest in the first three to five minutes include panic, hyperventilation, vertigo and changes in heart rate, blood pressure and heart rhythm, all of which can contribute to drowning.

***Short-term swim failure*** -- Those who survive the initial cold shock have a very limited span of time to attempt self-rescue. Within ten to fifteen minutes, muscles and nerves in the extremities lose heat, impairing grip, dexterity and speed of movement. Victims lose the strength to swim or to pull themselves from the water.

***Long-term immersion hypothermia –*** Hypothermia occurs when the body loses heat faster than it produces it. Generally long-term immersion hypothermia sets in after about 30 minutes. Symptoms are (in order): shivering, slurred speech and blurred vision, bluish lips and fingernails, a loss of feeling in extremities, cold bluish skin, confusion, dizziness, rigidity in the arms and legs, unconsciousness, coma and ultimately death.

***Post-immersion collapse*** – Cold-water immersion can kill even after the victim is pulled from the water. Heart problems, blood pressure problems and possible lung damage from inhaled water all can occur. Victims should receive medical intervention as soon as possible.

Knowledge of self-rescue techniques is vital, but may not be enough to save a paddler who cannot get out of the water before swim failure sets in. Questions an investigator should ask include: Was the victim wearing a PFD? Was the victim dressed for the water temperature? Was the victim paddling with a group that could assist with rescue? Was emergency equipment available to assist in the rescue?

Additional information on this subject can be obtained from:

***Essentials of Sea Survival***. Frank Golden, MD, PhD, and Michael Tipton, PhD. Human Kinetics Publishers: 2002

***Hypothermia, Frostbite, and Other Cold Injuries: Prevention, Survival, Rescue, and Treatment*** (2nd edition). Gordon Giesbrecht, PhD, and James A. Wilkerson, MD. The Mountaineer Books: 2006.

***Survival in Cold Waters: Staying Alive***, Transport Canada, TP 13822 http://www.tc.gc.ca/MarineSafety/Tp/Tp13822/menu.htm

## 11. Human Errors

As in most endeavors, human errors are most often committed by the inexperienced, but they are also sometimes committed by the experienced paddler who has become complacent, and occasionally by the experienced paddler pushing the edge of the envelope. As in any investigation involving a vessel, the investigator will need to look at the issue of human (or operator) error.

By far the most common error in flatwater situations is not wearing a PFD or wearing it improperly (not zipped or buckled). The investigator should also be aware that whitewater paddlers almost always wear a PFD, but the PFD may come off due to the force of the water and be washed downstream and not found.

***Most Common Acts of Omission to Consider:***

Many inexperienced paddlers ***fail*** to take an action that experienced paddlers often consider routine, such as:

- Failure to check the weather report before heading out
- Failure to ensure the paddler's experience and/or equipment capabilities meet the anticipated trip challenges
- Failure to advise family or friends of plans/time frame/location for their paddling excursion (also known as "float plan")
- Failure to understand the stability of the craft
- Failure to take seriously the risks associated with the sport
- Failure to recognize the hazards and avoid them
- Failure to wear or carry the appropriate personal protective equipment

***Most Common Acts of Commission to Consider:***

Paddlers may also ***commit acts*** that contribute to their situation, such as:

- Disregarding a forecast of weather that would be dangerous for a paddler
- Pushing the envelope in terms of attempting stretches of water that are above the experience and ability level of the paddler
- Choosing the wrong boat and equipment for the intended water
- Consumption of alcohol or drugs

On-the-water skills training is invaluable for new paddlers and for paddlers interested in improving their abilities. Investigators should inquire what training an accident victim and others in the paddling party have had, including both boating safety courses and specific, hands-on paddling skills courses. Other relevant questions are how long/often the victim has been paddling and the degree of experience he/she has with the type of water on which the accident occurred.

It is highly recommended that paddlers travel in groups of at least three boats, a lead boat directed by the most experienced paddler, a sweep boat bringing up the rear, and the middle boat(s). This configuration enables the most experienced paddler to watch for hazards, and prevents less skilled paddlers or those lacking physical stamina from becoming separated from the group. It also provides the safety of numbers; in case of an accident, others in the group can assist with rescue, while there will be at least one boat free to go for help.

## 12. Summary

In conducting an investigation of a paddlesports accident, it is important that the investigator:

Consider and record on the report the many external conditions present at the scene at the time of the accident. (It may be necessary to include a supplemental page to the official report to document factors that are critical to a valid determination of causation.) Note the safety equipment onboard and the condition of both equipment and boat. Include the make, model and other information in the report.

It is recommended that officers who work areas where paddlesport accidents are common or likely establish a rapport with the local paddlesport community in their area when feasible.

Investigators should also be encouraged to make contact with some of the professional paddlesport organizations such as NASBLA Paddlesports Committee, American Canoe Association, American Whitewater, et al., for guidance on technical questions.

**Photos courtesy of the American Canoe Association**

Appendix A : Wave Height Chart



**Table 4-1**
**Beaufort Wind Scale**

| SCALE | WIND (knots) | SEA INDICATIONS | WAVE HEIGHT (feet) |
|---|---|---|---|
| 0 | Calm | Mirror like. | 0 |
| 1 | 1-3 | Ripples with appearance of scales. | 1/4 |
| 2 | 4-6 | Small wavelets, glassy appearance, do not break. | 1/2 |
| 3 | 7-10 | Large wavelets, some crests begin to break, scattered whitecaps. | 2 |
| 4 | 11-16 | Small waves, becoming longer, fairly frequent whitecaps. | 4 |
| 5 | 17-21 | Moderate waves, pronounced long foam, many whitecaps. | 6 |
| 6 | 22-27 | Large waves begin to form, white foam crests are more extensive, some spray. | 10 |
| 7 | 28-33 | Sea heaps up, white foam from breaking waves begins to be blown in streaks along the direction of the waves. | 14 |
| 8 | 34-40 | Moderately high waves of greater length, edges of crests break into spindrift, foam blown in well-marked streaks in the direction of the wind. | 18 |
| 9 | 41-47 | High waves, dense streaks of foam, sea begins to roll, spray affects visibility. | 23 |
| 10 | 48-55 | Very high waves with overhanging crests, foam in great patches blown in dense white streaks, whole surface of sea takes on a white appearance, visibility is affected. | 29 |

# INVESTIGATING PADDLESPORTS ACCIDENTS: Issues for Consideration

Paddlesport accident investigations can involve unique factors. Error in judgment, lack of experience, lack of proper preparation, and inappropriate type of paddlesport vessel and/or equipment for the environment and/or conditions are all important issues to be considered while conducting investigations of paddlesport accidents.

**NOTE:** Consideration of the following issues is meant to supplement/add to the information that was compiled for the primary accident investigation report. The intention of concentrating on these additional issues is to dig deeper into the mindset and background of victims involved in paddlesport accidents. The goal is to achieve a better understanding of the trends and problems associated with this high risk category of boats and associated accidents.

***Critical issues to note:***

- Specific type/model of kayak/canoe involved in the accident
- Wind direction and speed
- Water and air temperature
- Depth, width, velocity and cubic feet per second (CFS) of the river (For some rivers, the U.S. Geological Survey maintains gauges which measure CFS. These readings are available at http://waterdata.usgs.gov/oh/nwis/rt)
- Affects, if any, of tidally-affected waters on the incident

***Environmental conditions to consider that may have contributed to the accident. It is helpful to not only document water conditions at the time of the accident, but also the potential cause of changes to those conditions that may/may not have been anticipated:***

- Hazardous water conditions caused by:
    - Storms/strong winds
    - Recent heavy rainfall
    - Melting runoff
    - Dam water releases
    - Tidal currents
    - Riptides-strong but narrow currents that push away from shore, formed especially around storm events.
    - Tide rips-turbulence caused by currents that flow across each other in a river or a sea.
- Natural configurations occurring in the river at the location of the accident:
    - *Strainers*
    - *Undercut Rocks*
    - *Manmade Entrapments*
    - *Foot Entrapment*
    - *Broaches*

- *Entanglement*
- *Vertical Pin*
- *Hydraulics* or *Low Head Dams*
- *Eddy currents*

***Most Common Acts of Omission to Consider:***

Many inexperienced paddlers ***fail*** to take an action that experienced paddlers often consider routine, such as:

- Failure to check the weather report before heading out
- Failure to ensure the paddler's experience and/or equipment capabilities meet the anticipated trip challenges
- Failure to advise family or friends of plans/time frame/location for their paddling excursion (also known as "float plan")
- Failure to understand the stability of the craft
- Failure to take seriously the risks associated with the sport
- Failure to recognize the hazards and avoid them
- Failure to wear or carry the appropriate personal protective equipment

***Most Common Acts of Commission to Consider:***

Paddlers may also ***commit acts*** that contribute to their situation, such as:

- Disregarding a forecast of weather that would be dangerous for a paddler
- Pushing the envelope in terms of attempting stretches of water that are above the experience and ability level of the paddler
- Choosing the wrong boat and equipment for the intended water
- Consumption of alcohol or drugs

***Other Issues to Consider:***

- Paddling against the wind, especially above 10 or more knots, can be very tiring.
- Paddling against a 2 knot current can slow forward progress (sea kayakers normally use a rule of thumb that they can paddle at 3 knots).
- When paddling upstream, a wind blowing with the current can magnify the effort needed to make forward progress.
- A wind blowing against the current can create a significant chop.
- Tides are affected by phases of the moon, atmospheric pressure, wind, and rain. Tides and currents can have areas of localized effects resulting from narrowing of a channel, bridge abutments and embankments, changes in water depth, and other factors.
- Existence of whirlpools/suck holes
- What training an accident victim and others in the paddling party have had, including both boating safety courses and specific hands-on paddling skills courses?
- How long/often the victim has been paddling, and his/her degree of experience with the type of water on which the accident occurred.