CHAPTER 11

FIELD SAFETY

This chapter is intended to assist field personnel in the safe performance and collection of water quality data. Fieldwork requires an awareness of potential hazards and knowledge of basic safety procedures. Field personnel routinely come in direct and indirect contact with waterborne pathogens, chemicals, and potentially hazardous plants and animals. Safety depends on using common sense and being aware of your surroundings. Advanced planning can eliminate many safety hazards, or at least reduce them.

Basic Safety Preparation

Basic preparations should become routine before every sampling. At a minimum, complete a plan for each field trip, and leave it at a designated location in the office. The trip plan should include the following information:

- the names of participants, including guests and observers, with emergency contact information
- a basic itinerary, including where and when sampling will occur, along with departure and return times and dates
- hotel information and contact phone numbers (for overnight trips)
- cell-phone numbers or radio frequencies

Remember:

- Fieldwork should be carried out in pairs. Always carry a cell phone or other communication device.
- Carry basic safety equipment: a first-aid kit, a flashlight, boots, rain gear, and antibacterial soap or hand cleaner.
- Be aware of changing weather conditions and the potential for flash floods, storms, or tornadoes.
- Be aware of potential hazards at a monitoring site.
- Make a habit of carrying a packet of general safety information in each vehicle or boat—
  - material-safety data sheets (MSDSs) for preservatives
  - basic first-aid protocols
  - emergency phone numbers
  - locations of emergency facilities (hospitals, police and fire departments, U.S. Coast Guard)

Use the checklist in Table 11.1 to ensure that all appropriate safety equipment is available during a sampling trip.

Table 11.1. Basic safety-equipment checklist.

Yes	No	Safety Items
		Waders, hip boots, rubber knee boots
		Personal flotation device
		First-aid kit
		Fire extinguisher
		Flashlight and spare batteries
		Cell phone and marine radio
		Rain gear
		Hat, sun screen, and sunglasses
		Drinking water or sports drinks
		Safety cones, orange safety vest (for working on bridges)
		Toolbox with basic tools
		Antibacterial soap or hand cleaner
		Spill kits (for preservatives)
		MSDSs for preservatives
		Hand-held eyewash unit
		Protective goggles
		Container to carry preservatives
		List of emergency phone numbers and office contacts

Transporting Chemicals

Ensure that MSDSs are available for all chemicals used on a trip. These reports describe signs and symptoms of exposure, list first-aid procedures, and give details on cleaning up spills. Here are tips to remember:

- Protect field personnel by securing all chemicals, using containers that will control the material in the event of an accident.
- Dilute concentrated acid to 1:1 before traveling to the field.
- Use a secondary container (for example, an ice chest) to protect against breakage and spills.
- Carry a spill kit containing neutralizing agents. (The most common and dangerous chemicals carried during sampling trips are sulfuric and nitric acids).

- Use safety glasses and gloves when handling acid preservatives.
- Label all chemical containers clearly.
- Never carry large quantities of acid in the field. Always transfer the acid to smaller containers or, for sulfuric and nitric acids, use premeasured vials. Although there is always a chance of a spill, the risk is significantly reduced by transporting small quantities.
- Do not pipette by mouth. Always use mechanical pipettes or pipette bulbs.

Consider these safety tips for transporting gasoline:

- If extra gasoline is carried, ensure that it is transported and stored in approved containers.
- Remove portable tanks from vehicles or boats before filling them with fuel. Touch fuel pipes or tanks with the spout to prevent buildup of static electricity.
- Do not fill tanks completely full; leave room for the gasoline to expand.
- Cap tanks tightly to prevent vapors from escaping.
- Clean up spills immediately and air used rags before storing them. Store containers in a well-ventilated area away from the engine.

Wading

Follow these guidelines on wading:

- Stream flow can be deceiving. If there is any question about safety, do not get in the water.
- Do not attempt wading in a stream where the depth multiplied by the velocity is 10 ft^2/s or more. For example, a stream only 2 ft deep with velocities of 5 ft^2/s or more can be dangerous (Lane and Fay 1997).
- Always wear a Coast Guard–approved personal flotation device (PFD) while wading. Although the stream may not appear deep, depressions, holes, or loose footing may cause a fall.
- Wear hip boots or chest waders. Boots and waders protect against cold, contaminants, and underwater objects. Be aware of the possibility of slipping and going under water while wearing them.
- For waders with loose-fitting tops, consider wearing a belt to prevent them from filling with water.
- Be aware of surrounding conditions. Watch for floating debris, areas of quicksand, underwater hazards, and deep pools. Watch the stream stage, especially if there is a chance it could rise rapidly.

Working from Bridges

Samples are often collected from bridges. Such work is very dangerous, so take steps to minimize the risks. Use basic safety equipment for bridge sampling, including reflective vests, orange safety cones, and a revolving amber light.

According to Texas Department of Transportation requirements:

- Use an activated flashing or revolving light on vehicles involved in short-term, short-duration work (60 minutes or less) on the road shoulder.
- Use orange safety cones, in addition to the flashing amber light, for vehicles parked on the shoulder for longer than 60 minutes. The cones should begin at 40 ft ahead of the vehicle where the posted speed limit is 30 miles per hour or less, up to 250 ft ahead of the vehicle where the speed limit is 70 mph.

If a field vehicle is parked on the bridge:

- Never stand in front of it while sampling. Field personnel cannot see traffic, and drivers cannot see field personnel.
- Sample away from the vehicle at a location where you can observe traffic from both directions.
- Be aware of any boat traffic.
- Wear a Coast Guard–approved PFD when working on bridges over large rivers.

Working from Boats

Use a boating-safety checklist when planning a trip (Table 11.2). Leave an itinerary for each boat trip at a designated location in the office. The plan should include:

- the date and purpose of the trip
- the names of all operators and any guests or observers, along with emergency contact information
- the destination and route
- the time of departure and estimated time of return
- a cell-phone number or radio frequency
- the type of boat, including its color, length, and identification number and any other unique features

Follow these precautions when using a boat:

- Know its capacity. Look for a capacity plate near the operator's position or on the transom indicating the maximum capacity (weight or persons). The maximum weight includes the combined weight of passengers and gear.
- On outboard powerboats, check the capacity plate for the maximum horsepower rating; do not exceed the rating.
- Use caution when refueling a boat. Check the entire fuel system for leaks, and tighten connections frequently. Turn off the engine and all electrical equipment before adding fuel to the tanks. Never smoke or strike a match while fueling or near a fueling dock.
- Make sure the boat is in good operating condition and full of gas before taking it out on the water. Use the checklist in Table 11.2 to ensure that the boat is ready for use.

Table 11.2. Boating-safety checklist.

TRAILER	YES	NO	COMMENTS:
Sizes of coupler and ball hitch match			
Tire pressures are at the maximum noted on the rim			
Tire treads are at least $^{3}/_{32}$"			
Tires are in good condition			
Brake lights and turn signals function			
Safety chains are attached in an *X* under the coupling			
All boat straps are tight			
License plate is present and firmly attached			
Trailer stand is secure			
BOAT	**YES**	**NO**	**COMMENTS:**
Boat plugs are present			
Battery is charged			
Gas tank is full			
Anchor and rope are aboard			
Navigation lights are operational			
Emergency paddles are aboard			
First-aid kit is available			
First extinguisher is charged and accessible			
Flashlight with working batteries is available			
An air horn or whistle is aboard			
Rain gear is aboard			
Personal flotation devices are available for every person on board			
The emergency kill switch for the boat motor is functioning			
Radio or cell phone is available and functioning			

- Check weather conditions before departure. If a storm comes up while on the water, head for shore. Always carry a marine radio or cell phone. Never go boating alone.
- Do not wear waders and hip boots in a boat because they could be a safety hazard if the boat should tip or a person is thrown out. When wearing waders or hip boots is necessary, a life jacket must be worn.
- Always wear a Coast Guard–approved life jacket.

- Remember that Texas law requires operators of vessels involved in any collision, accident, or other casualty that results in death or injury to any person or property damage exceeding $500 to file a complete report of the accident within 30 days. Obtain report forms from the TPWD. Keep in mind that vessel operators involved in a boating accident must stop and render whatever assistance is necessary unless such actions would endanger their own vessel, crew, or passengers. Operators must give their name, address, and vessel identification number in writing to any injured person and to the owner of any damaged property.

Personal Flotation Devices

Approximately 90 percent of all boating fatalities are from drowning. Virtually all drowning victims are not wearing personal flotation devices, or are wearing inadequate ones. All boats must be equipped with life jackets or PFDs approved by the U.S. Coast Guard (Table 11.3). The quantity and type depend on the length of the boat and the number of persons aboard. Additional information is available at the U.S. Coast Guard Web site (see Appendix A).

Follow these guidelines:

- PFDs must be in good condition. Regularly test the buoyancy in shallow water or a swimming pool.
- Inspect the PFDs for weakened material or insecure snaps or zippers.
- Inflatable PFDs require maintenance. Replace spent cartridges in inflatable PFDs or tag used cartridges as out of service, so they are not used accidentally.

Table 11.3. Types of personal flotation devices.

Type	Conditions of Use	Positives	Negatives
I	Offshore work or remote areas where rescue may take a while	Excellent for flotation and will turn most unconscious persons face up in the water.	None.
II	Near-shore vests	Good for calm waters and fast rescues.	Lacks the capacity to turn wearers face up.
III	Vests or flotation aids	Good for calm waters and fast rescues.	Will not turn an unconscious person face up and should not be used in rough waters.
IV	Throwable devices—cushions or buoy rings	Designed to be thrown to someone in trouble.	Not good for long hours in the water, rough water, nonswimmers, or the unconscious.
V	Type V, (special-use) devices are designed for specific activities. They are only appropriate for use in accordance with the specific instructions on the label of the device.		

- Inflatable PFDs are not recommended for nonswimmers.
- Ensure that all PFDs are the proper size for the intended wearer. Read the label to ensure that it is the right size for a person's weight and chest size.
- Keep all PFDs readily accessible.
- Make sure all sampling personnel wear PFDs when in boats and when wading. TCEQ SWQM personnel are required to wear PFDs when under way.
- For boats 16 feet long or longer, keep an extra Type IV PFD immediately available, besides those required for passengers.
- Select PFDs that are appropriate for the area being sampled.

Collecting Fish

Electrofishing

Electrofishing is hazardous work. The batteries and generators used provide more than enough current to electrocute a person. **Use extreme caution. Never electrofish alone.** Ensure that everyone associated with electrofishing is aware of the hazards and safety requirements before beginning the project.

General Electrofishing Safety

- Use only commercially produced electrofishing equipment.
- Be familiar with the equipment and inspect it before each use. Correct any equipment problems immediately. If equipment must wait to be repaired, tag it "out of service" so it won't be used accidentally.
- Evaluate the equipment annually during a preventive-maintenance inspection.
- Do not allow wiring splices. If connections are necessary, ensure that the rating of the connector is at least as high as that of the wire.
- Ensure that at least one member of the crew is trained in CPR. Consider carrying a portable automated external defribrillator.
- Inspect all dip nets to ensure they are made of nonconductive material and that they are long enough to keep the user's hands out of the water.

Backpack Electrofishing

- When backpack electrofishing, wear neoprene waders and rubber lineman gloves. The rubber lineman gloves must be rated for at least 1,000 volts. Never wear breathable waders, as electric current can pass through them.
- At least two people are required when backpack electrofishing (one to carry the backpack and the other to net fishes), though three make the optimal crew.
- Ensure that batteries used on backpack electrofishing units are of a gel type that will not leak when tipped or overturned.
- Check hip and shoulder straps to make sure they are of the quick-release type, are not damaged, and are long enough for the person who will use them.
- Ensure that the backpack unit is equipped with a trip switch that breaks the circuit if the user falls. This switch must be the type that is manually reset before reestablishing the circuit.

Boat Electrofishing

- A minimum of three people are required when electrofishing from a boat.
- All personnel must wear a Coast Guard–approved PFD, rubber gloves rated for a voltage above that used by the electrofishing unit, and rubber boots when electrofishing from a boat—with no exceptions.
- Hearing protection is highly recommended.
- Members of an electrofishing team must be aware of each other. The boat driver should watch those on the front netting fish, while the netters need to take care of those around them while maneuvering the nets.
- Ensure that all junction boxes are weatherproof or rain tight, depending on their use. Junction boxes with switching equipment must be weatherproof.

Working with Nets

Remove all jewelry from hands and wrists and from around the neck when using gill nets or other nets with large mesh. Nets can get caught on watchbands, bracelets, necklaces, or rings. Since gill nets are deployed from boats, it can become a serious safety issue if someone gets tangled or a piece of jewelry gets hooked to the net. The driver of the boat must be very conscious of those deploying the nets. All personnel must wear a Coast Guard–approved PFD.

Working with Fish

Take care when working with catfish or other fish with barbs. When handling catfish it is easy to receive a puncture wound from barbs on the pectoral or dorsal fins. These can be very painful and are a risk for infection. Infections that occur after contact with coastal waters should be checked by a doctor.

Contaminated Water

Always consider the possibility that the water being sampled may be contaminated with pathogens or hazardous chemicals. Use caution and extra protection when working in or around water with known or suspected contamination. Use sample tags to indicate the level of contamination so the laboratory can handle the sample appropriately. Communicate known or suspected contamination to all personnel who could come in contact with a contaminated sample.

Waterborne, disease-causing organisms (pathogens) are found in nearly all surface water systems. Pathogens enter surface water through untreated sewage discharges and bypasses, storm and agricultural runoff, and direct contact. Bacteria, viruses, and other pathogens can occur in the most pristine environments. Never drink sample water, no matter how pristine the environment appears. Consider making antibacterial soap or hand cleaner a routine item to carry while in the field.

When working in water bodies with questionable water quality, consider wearing gloves and waders when in contact with the water. Equipment used in contaminated water bodies should be washed after use.

Weather

Weather can change rapidly and create unexpected situations for sampling personnel, whether they are in a boat or in isolated sampling areas. Check local weather forecasts frequently. Be alert to visual weather cues, such as developing clouds, wind shifts, and graying skies.

If you see these signs and you are in a boat head for shore immediately. Head the bow into the waves at a 45° angle. Reduce speed, but keep enough power to maintain headway. Make sure all passengers and equipment are secured in case of rough water.

Leave small creeks and rivers to avoid flash floods. Don't cross low-water crossings, as the integrity of the underlying roadway is uncertain. Floating debris may damage the vehicle, or even push it from the roadway.

Lightning Safety

When you first see lightning or hear thunder, seek shelter either in a vehicle with the windows closed, or in a substantial building. Avoid high ground, water, and open spaces. Unsafe shelter includes canopies, small picnic or rain shelters, or the vicinity of trees. Activities should be suspended until 30 minutes after the last observed lightning or thunder.

Temperature Exposure

The two most common health risks faced by field staff are the result of temperature extremes. Extremes of air temperature occur in all parts of the country. The ideal comfort range for humans is 10–32°C (60–90°F). Hypothermia (cold) and hyperthermia (heat) normally occur outside this range.

Cold Emergencies

Hypothermia is a condition of reduced body temperature caused by exposure to cold, and aggravated by wet clothes, wind, hunger, and exhaustion. Hypothermia can occur with air temperatures above 16°C (60°F) under wet or windy conditions.

Warning Signs

Symptoms of hypothermia include uncontrollable fits of shivering, incoherence, listlessness, fumbling hands, frequent stumbling, drowsiness, and the inability to get up after resting.

Treatment

Remove the victim from the cold and into a dry, warm place. Take the following temporary measures until medical help is available: Replace wet clothes with dry ones. Warm the body slowly. Give warm, nonalcoholic drinks.

Prevention

The best way to prevent hypothermia is to stay warm and dry. Put on rain gear before it rains. Dress in layers and add more before getting cold. Find shelter before conditions become severe. During colder weather, carry a complete change of dry clothes.

Heat Emergencies

Hyperthermia is caused by increasing body temperature due to exposure to extreme heat. The two forms of hyperthermia are heatstroke and heat exhaustion. Heat emergencies can be brought about by a combination of factors: physical exertion, heavy clothing (e.g., waders), humidity, no breeze, air temperature, and the rate of fluid intake. Working in the extreme summer heat creates a very real threat of heat-related stress.

Warning Signs

Symptoms of hyperthermia include chilling, headache, unsteadiness, dizziness, nausea, dry skin (hot and red—heatstroke; cool and pale—heat exhaustion), rapid pulse, and muscle pain and spasms.

Treatment

General treatment for heat emergencies involves cooling down and giving plenty of fluids. **Do not give salt tablets**. A common symptom of dehydration is a headache. Heatstroke requires immediate medical attention and can cause death. Cool down victims of heatstroke quickly and watch for signs of shock. Call 911 or, if in an isolated area, transport the victim to a medical facility immediately.

Prevention

- Hydrate well before working outdoors. Drink water in moderate amounts every 15 minutes. Do not rely on thirst to indicate dehydration.
- Avoid alcohol, caffeinated drinks, and sodas. These liquids are not water substitutes and can increase the rate of dehydration.
- Wear lightweight, light-colored clothing and a wide-brimmed hat.
- Start work early and finish before the hottest part of the day. Find some shade and take breaks during the day.

Plants and Animals

Certain insects, reptiles, and plants are always potential hazards for field personnel. Tables 11.4 and 11.5 sum up the most common plant and animal hazards encountered by field personnel. Carrying a first-aid reference is recommended for all field activities.

Table 11.4. Common wildlife hazards.

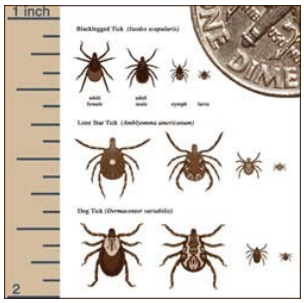
Animal	Characteristics and Habitat	
SPIDERS, SCORPIONS, TICKS, BEES and WASPS		
Black widow spider	Inhabits fallen branches and lives under objects. Red and brown widow spiders are less common, but do inhabit the Gulf Coast region. Take care when reaching into small, dark spaces. If bitten by a black widow, seek medical attention as soon as possible.	
Brown recluse spider	Frequents areas of human habitation and prefer dark spaces. Found outdoors in sheltered corners, among loose debris; indoors on the floor and behind furniture. Take care when reaching into small, dark spaces. If bitten by a brown recluse, seek medical attention as soon as possible.	
Scorpions	Nocturnal, sensitive to vibrations. Not easily seen in the wild. Field boots are a favorite hiding place. Most scorpions are not dangerous and do not attack. The poison of most North American species is not lethal to humans, but scorpions do inflict a painful sting. Scorpion stings may not require medical attention.	
Ticks	Small, less than 3 mm (< ⅛ in) long. Clamp to hosts using a dart-like anchor located just below the mouth. Wear long pants and tuck pants legs into socks. Use a repellent containing DEET. Check for ticks during and after field work.	

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Table 11.4. Common wildlife hazards (continued).

Animal	Characteristics and Habitat	
SPIDERS, SCORPIONS, TICKS, BEES and WASPS (continued)		
Bees	Vary in size from 2 mm (0.08 in) to 4 cm (1.6 in) long. Locations vary from ground nests to trees and human-built structures. • Avoid beehives and wasp nests. • Scrape off the stinger with a knife or other flat object (e.g., a credit card). • Wash well with soap and water. • Use a cold pack to reduce swelling. • Apply an over-the-counter sting ointment or a solution of water and baking soda.	
Wasps	Vary in size from minute to 5 cm (2 in) long. Adults have a narrow waist between the first and second abdominal segments. **Habitat:** Locations vary from ground nests to trees and human-built structures. Members of a field team who are allergic to insect bites or stings should notify the rest of the team and should carry a sting kit for use in emergencies. Symptoms of an allergic reaction include pain, swelling of the throat, redness or discoloration in the area of the sting, itching, hives, decreased consciousness, and difficult or noisy breathing.	
ALLIGATORS and SNAKES		
Alligator	Found in swamps, rivers, and lakes, mainly in eastern and southeastern Texas. Treat alligators with extreme caution. Never approach an alligator on land or in water. During breeding and nesting season (April–May) alligators can be very aggressive. They can outrun humans for short distances. If sampling involves fish collection, get the specimens out and away from the water as soon as possible.	

Table 11.4. Common wildlife hazards (continued).

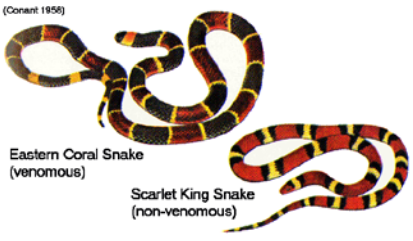
Animal	Characteristics and Habitat	
ALLIGATORS and SNAKES (continued)		
Cottonmouth (water moccasin)	Unlike other water snakes, swims with head well out of water. Never far from water. Most active at night, although may be seen sunning during the day. Found in lowland swamps, lakes, rivers, irrigation ditches, canals, and rice fields. Take care when electrofishing and seining near logjams, fallen trees, and undercut banks.	
Copperhead	Found in wooded hillsides with rock outcrops above streams or ponds, edges of swamps, and periodically flooded coastal plains; near canyon springs and dense river-cane stands along the Rio Grande. Favorite warm-weather habitats include stone walls, piles of debris, rotting logs, and large, flat stones near streams. Best defense is avoidance. Most snakes will go the other way unless unusually agitated or disturbed.	
Rattlesnakes	Found in arid and semiarid areas from plains to mountains; brushy desert, rocky canyons, bluffs along rivers, sparsely vegetated rocky foothills. When disturbed they normally stand their ground, lifting their heads well above the coils. The warning is a buzzing sound.	
Coral snake	Distinctly colored with wide red and black bands separated by a narrow, bright yellow band. Red and black bands never touch. At least two harmless snakes (the scarlet king snake and scarlet snake) have similar color patterns. Found in densely vegetated upland areas near ponds or streams in hardwood forests, and in rocky hillsides and canyons. Usually seen under rotting logs or leaves. Coral snakes must chew prey. The venom is a strong neurotoxin and bites can be fatal.	

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Table 11.5. Common plant hazards.

Plant	Characteristics and Habitat	
Poison ivy (poison oak)	Climbing poison ivy has alternate, trifoliate leaves with aerial roots that grow straight and are fuzzy. Found in most environments. Non-climbing poison ivy lacks aerial roots. The leaves are the same shape as those of climbing poison ivy, but are larger and broader. Vines without leaves can still cause a rash. If a piece of vine is used as firewood, the oily resins can be released into the air. People who breathe in the smoke and soot may develop serious inflammation of respiratory mucous membranes. The resin can also remain on unwashed clothing and equipment. Poison ivy and poison oak are two species in the same genus.	