Fisheries Safety Handbook

Professional Safety Committee
of the
American Fisheries Society

December 2008

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Committee Members:
Bill Fisher (OK), Chair
Laura Csoboth (IL)
Don Dennerline (GA)
Casey Harthorn (NM)
Chris O'Bara (WV)
Larry Olmsted (ID)
Dennis Reicke (MS)
Roger Rulifson (NC)

American Fisheries Society
5410 Grosvenor Lane
Bethesda, Maryland 20814, USA
301-897-8616
www.fisheries.org

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Preface

The Professional Safety Committee was formed in 2005 by American Fisheries Society President Chris Kohler. It was reformed 2006 and continued through 2008. The committee was given the charge of creating greater awareness of safety issues within the fisheries profession and working with the Continuing Education Committee to promote continuing education opportunities on this issue at chapter, division and parent society meetings. Justification for the committee's charge came from the 2005-2009 Strategic Plan of AFS:

Goal ITO 3, Professional Stature.—Enable researchers, educators, managers, and administrators involved in the fields of fishery and aquatic science and resources management (aquatic resource professionals) to be recognized and valued by employers and the public.
Strategy ITO 3.1.—Maintain a leadership role in enhancing salary, safety, and working conditions for fishery professionals; prioritize work with organization whose benefits fall below indexed mean values.
Target ITO 3.3.a.—Salary, safety, and working conditions for fishery professional continue to improve.

The committee consisted of: Laura Csoboth (IL); Don Dennerline (GA); Bill Fisher (OK), Chair; Casey Harthorn (NM); Chris O'Bara (WV); Larry Olmsted (ID); Dennis Reicke (MS); and Roger Rulifson (NC). Fred Heitman (TN) and Steve Sellars (NC) contributed to the report.

The committee compiled information on safety issues that are pertinent to fisheries and aquatic resource professionals. These issues included: defensive driving, boating safety, electrofishing safety, CPR/AED (automated external defibrillator) and first aid training, fish handling safety (injuries from spines and fins), pesticide application certification training (rotenone and aquatic herbicides), underwater and diving safety, and laboratory safety (chemical safety, slippery floors).

The information was compiled into this Fisheries Safety Handbook. Periodic revisions of this handbook are expected. Although the basic philosophies of health and safety are quite constant, specific issues or components of health and safety evolve over time, sometimes quite rapidly.

Special thanks go to the following for reviewing the handbook sections: G. Hill (US Geological Survey) Boating Safety; K. Pope (Nebraska Cooperative Fish and Wildlife Research Unit) and R. Hansen (New Mexico Dept. of Game and Fish, Fisheries Division) Electrofishing Safety; A. Henshaw (HDR Co.); Kelly Shook (Health Sciences Coordinator, Environmental Health and Safety, East Carolina University) Laboratory Safety; and Steve Sellars (Eastern Carolina University).

Bill Fisher, Chair
Professional Safety Committee
December 2008

Introduction

Laura Csoboth and Bill Fisher

Virtually every fisheries job poses some hazard to personal health and safety. Although incidents and accidents occur, many can be prevented through proper training, awareness of risk, and enforced safety precautions. Unfortunately, it can often take a serious and even tragic incident to spur the creation and implementation of successful health and safety programs. Therefore, the purpose of this handbook is to assist researchers, educators, managers, and administrators involved in the fields of fishery and aquatic science and resources management (aquatic resource professionals) in nurturing and creating a safe and productive work environment, no matter the surroundings.

Four general elements are necessary to implementing a successful safety and health management program:

1. Management leadership and employee involvement

Safety programs need to be leadership-driven, engendering a culture of responsibility for safety and attitudes that improve performance and efficiency in the workplace. Supervisors must provide adequate infrastructure and resources to meet safety training requirements and equipment needs, while employees should embrace these efforts by helping to identify needed training/equipment, keeping abreast of safety information, and consistently implementing safety protocols. Safety is the responsibility of everyone in the workplace.

2. Work analysis

Injury to employees and damage or loss of equipment and facilities can be significant to individuals, supervisors, companies, agencies, and universities, especially in today's litigious society. Therefore, when accidents and near-miss incidents occur, safety managers should determine the cause(s) and devise ways to avoid similar, future incidents from occurring.

3. Hazard prevention and control

Hazards typically occur from one of the following: an unsafe task, improper equipment, the environment, or issues with personnel/management. While many strategies for accident prevention exist, an important and often over-looked component to hazard prevention is the project-specific health and safety plan. Project-specific health and safety plans force supervisors and project managers to anticipate risk and safety hazards that can be extremely variable depending on the task and adequately plan for equipment and training needs.

4. Safety and health training

Training can occur in many forms, but should always originate from trustworthy, sanctioned, and reliable sources (e.g., American Red Cross, Occupational Safety and Health Administration).

There are six sections to the handbook. The sections are: Defensive and Safe Driving, Boating Safety, Electrofishing Safety, Underwater and Diving Safety, CPR/AED and First Aid Training, Fish Handling Safety, Chemical Application and Hazardous Waste Safety, and Laboratory Safety. Each section was written independently and all were reviewed by subject matter professionals. Our focus was on safety information relevant to fisheries professionals. As such, our goal was to provide specific information about safety procedures for common fisheries activities and references to publications and websites for more general safety information.

This handbook is intended to be advisory in nature, informational in content, and does not provide industry standards for workplace safety nor does it create any legal obligations. Moreover, this handbook has been developed for general use by aquatic resource professionals within the United States. Therefore, particular emphasis was placed on the Federal Occupational Safety and Health Administration (OSHA), which enforces health and safety legislation within the United States. Fisheries professionals in nations other than the United States should disregard specific references to state and federal laws and regulations. We suggest that the principles described in this handbook are applicable to aquatic resource professionals everywhere. Researchers in other nations can modify the specific provisions pertaining to the United States and adopt guidelines consistent with the laws and regulations of their own government.

Defensive and Safe Driving

Dennis Riecke

Except for office work and field sampling, fisheries professionals and students will probably spend much of their career time driving to various job sites and water bodies. There are approximately 19 million automobile collisions each year that end 40,000 lives and result in 2,300,000 disabling injuries (National Safety Council 2006). One out of every nine drivers will be involved in a vehicle collision in any given year. Few drivers will never be involved in a vehicle collision.

Driving occurs in a variety of road and weather conditions that influence safe driving speeds and vehicle performance. Often, fisheries workers are towing boats or other equipment that affects vehicle performance and handling. Fisheries workers may use different vehicles, which they are not familiar with depending on their work activities. Driver unfamiliarity with a vehicle is a major cause of collisions. Driving is a complex task that we often take for granted, but it is one that demands the use of all of our senses and undivided attention to be undertaken safely. Regardless of how much vehicle operation experience you possess, you can benefit from a defensive and safe driving training course. The principles of defensive driving involve three interrelated steps: 1) see the hazard by thinking as far ahead as possible about what might happen, 2) understand the defense for specific hazards and apply the corrective defensive maneuver, and 3) act defensively when the hazard is recognized and the defense determined (Berry 1996).

Basic safe driving practices and guidelines can be found in most defensive and safe driver training courses. The guidelines below pertain to the situation that most fisheries workers experience—trailering a boat.

Vehicles pulling a trailer are four times more likely to be involved in a single vehicle accident, particularly during long-distance travel (Dark 1971). When towing a trailer and boat, make a conscious effort to “THINK BIG,” “THINK HEAVY,” and “SLOW DOWN.” Maintain a greater following distance to vehicles in front of you than normal and use caution when passing. The weight and force of the trailer will increase your braking distance. Learn how to detect and correct trailer fishtailing. When a trailer begins to fishtail due to high speeds, passing trucks, gusting winds and inadequate tongue weight, your towing vehicle will begin to sway. If this sway becomes too great, both the vehicle and the trailer will flip over. If the trailer starts to sway, let up on the gas pedal, hold the wheel securely and keep the wheel straight. DO NOT USE THE BRAKE OR OVERSTEER - both will make the swaying worse.

All trailers bear capacity information, which is usually displayed, on a plate or label affixed to the trailer tongue. These labels list the Gross Trailer Weight Rating (GTWR) and the Gross Axle Weight Rating (GAWR). These weights can be determined at a public scale. The gross trailer weight is the weight of the loaded trailer, unhitched and supported on a jack. To determine the gross axle weight, move the tongue and jack off the scale and reweigh the trailer. Determine the tongue weight by subtracting the gross axle weight from the gross trailer weight. The tongue weight should be 10-15% of the gross trailer weight. Wheel and tire size and condition influence capacity of a trailer. The most common towing problem is undersized tires, which become hot, sway more easily, wear out more quickly and carry a load less safely (Berry et al. 1983). The tire size needed to safely carry the recommended weight load is listed on the trailer capacity plate. State regulations may require that trailers exceeding a certain weight be fitted with brakes.

Trailer brakes, brake lights and turn signals extend the braking and signaling ability of the towing vehicle. These features should be checked frequently for proper operation. Nonfunctioning trailer lights are a commonly encountered situation due to their construction designs, wire quality and connections and the fact that they are submerged in water when launching and loading a boat. Trailer light life can be extended by disconnecting them and allowing them to cool prior to launching or by removing them altogether for this activity.

Trailer hitching equipment consists of the coupler, safety chains, hitch and ball. The coupler is the tongue mechanism that attaches the trailer to the trailer ball. The attachment should be secure and the hasp should be prevented from coming loose from the ball with a lock or hardened bolt to prevent the latch from being jarred open during transport. Safety chains should attach the trailer at separate points other than the bracket that holds the trailer ball. The hitch size and weight depend upon the tongue weight and gross trailer weight. Make sure the trailer coupler size and the trailer ball size are the same. Boats should always be attached to their trailer at multiple points. Straps or ropes should be used to secure the stern of the boat to the trailer. Wire rope or a wire cable is the best material to attach the bow of the boat to the trailer winch. The trailer winch should have a locking mechanism to prevent it from freewheeling after it is tightened.

Everything stored in your boat can and will blow away if it is not securely tied down. It is better to spend a few minutes securing all equipment in the boat prior to departure than having to stop and retrieve sampling gear and nets scattered along a roadway.

Every vehicle driven by a fisheries biologist should carry an emergency kit containing jumper cables, road reflectors, a flashlight and spare batteries, a basic tool kit, tire pressure gauge, oil, brake fluid, transmission fluid, radiator coolant and an empty spare gas can. Keep at least a quarter of a tank of gas in your vehicle at all times in case of an emergency.

In at least 35 states, insurance companies offer discounts for drivers who have completed a driving safety course. Contact your insurance company or your state department of public safety to inquire about safe driving courses. Such courses are available online through the National Safety Council at http://www.4tdds.com/?kbid=1064. We can all improve our safe driving skills. It's better to be safe than sorry.

References

Berry, C. R. 1996. Safety in fisheries work. Pages 63-81 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Dark, H.E. 1971. Know before you tow. *Family Safety Magazine* 30(2): 24-26.

National Safety Council. 2007. Defensive driving courses. http://www.4tdds.com/?kbid=1064

Boating Safety

Don Dennerline and Bill Fisher

Safe boating has never been more important for fisheries biologists who are working among an increasing number of watercraft on inland lakes and rivers and coastal areas. Fisheries biologists typically perform a number of tasks that require a variety of watercraft ranging from large and small motorboats to canoes and kayaks. Many references have been written about the operation of small watercraft (see Berry 1996), and the standard reference is *Chapman Piloting and Seamanship* (Maloney 2006).

There are many boating courses for training fisheries biologists on safe boating. These courses are available on the Internet, through state and federal agencies, by the U. S. Coast Guard, and organizations such as the National Safe Boating Council. All of these courses are designed to educate motorboat operators, particularly recreational boaters, on proper and safe boating skills to minimize the loss of life, personal injury, property damage, and environmental impacts. Rather than repeat information from these courses in this handbook, we direct the reader to the course websites listed at the end of this section. Each of these courses cover in varying detail the following training standards established by the National Association of State Boating Law Administrators (NASBLA):

The Boat.—Capacities and registration requirements, as well as characteristics of the boat types and terms such as length and classification; hull design, type, and material; propulsion requirement and fuel type.

Boating Equipment.—Personal flotation devices (PFDs), fire extinguishers, back-fire flame control device, ventilation systems, navigation lights, sound signaling equipment, and visual distress signals.

Trip Planning.—Checking local weather and hazards, filing a float plan, boat preventative maintenance, transporting and trailering, fueling, and pre-departure checklist and passenger communication.

Marine Environment.—Specific environmental laws and regulations for human waste and toxic substance disposal when operating motorboats in marine waters.

Safe Boat Operation.—Operator responsibilities, understanding the influence of and laws pertaining to drugs and alcohol during boat operation, navigation rules of the road, aid to navigation, docking and mooring, anchoring, and effects of carbon monoxide.

Emergency Preparedness.—Rendering assistance, capsizing emergencies, falls overboard emergencies, coldwater immersion and hypothermia, fire emergency preparedness, running aground prevention and response, and accident reports.

For a complete list of NASBLA approved boating safety courses, visit http://www.nasbla.net/courseListing.php

Just as the seatbelt is the single most important safety device for an automobile operator and passengers, so is the PFD for a motorboat operator and passengers. For example, the U. S. Department of Interior requires that employees wear a PFD at all times while on board motorboats less than 26 feet in length and when in open spaces (or when directed by the operator) while on motorboats 26-65 feet in length. Fisheries biologists should wear PFDs at all times while on or operating motorboats.

Trained with the proper knowledge about boating safety, there is no substitute for motorboat operator experience. Fisheries biologists should practice all aspects of motorboat operation, including trailering and launching boats, and emergency procedures.

Below are four tips for safe boating from America's Boating Course: http://www.americasboatingcourse.com/html/boating_safety_overview.htm. Each year hundreds of lives are lost, thousands are injured, and millions of dollars of boat and personal watercraft (PWC) insurance claims are filed because of recreational boating accidents that could be prevented. Too often power boating outings turn tragic. You—as a boat operator, passenger, or concerned individual—can make a difference. Here are four boat safety tips:

Boating Safety Tip #1: Wear Your Life Jacket

Most people who are killed while boating drown—and most people who drown are not wearing a life jacket (PFD). When you fall overboard, there is rarely time to get to a stowed life jacket. Modern life jackets are smaller and more comfortable than ever making it easy to "Wear It!" at all times.

Boat Safety Tip #2: Stay Sober in Your Boat

A boat operator with blood alcohol content above .10 is ten times more likely to die in a boating accident than an operator with zero blood alcohol. Other stressors such as sun, vibration and noise affect the body more when drinking alcohol. Operating a boat under the influence of alcohol or drugs is illegal in all states and a violation of Federal boating law.

Boater Safety Tip #3: Take America's Boating Course

Seventy percent of recreational boating accidents are caused by inexperience and lack of knowledge, particularly factors such as failure to pay attention, carelessness, recklessness, excessive speed, and failure to watch for hazards. America's Boating Course (http://www.americasboatingcourse.com/) is inexpensive and quick—a great way for you to learn boat safety, the rules of the road, and boating regulation. In many states, this safe boating course gives you the knowledge needed to pass your boat license or safety certification exam.

Boating Safety Tip #4: Get Your Boat Checked

The Coast Guard Auxiliary and United States Power Squadrons offer a free Vessel Safety Check (VSC).

Boating safety websites

American Boat Operators Course
http://www.boatingcertificate.com/

America's Boating Course (sponsored by USCG Auxiliary & USPS)
http://www.americasboatingcourse.com/

Boat Ed
http://www.boat-ed.com/

BoaterExam
http://www.boaterexam.com/overview1.html

Boater 101 Course
http://www.boater101.net/courseintro.aspx

BoatUS
http://www.boat-ed.com/

Boat Safe (Nautical Know How Inc. course; basis for current USDOI MOCC Manual)
http://www.boatingbasicsonline.com/

National Safe Boating Council
http://www.safeboatingcouncil.org/

U S Coast Guard, Office of Boating Safety
http://www.uscgboating.org/

References

Berry, C. R. 1996. Safety in fisheries work. Pages 63-81 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Maloney, E. S. 2006. Chapman piloting & seamanship, 65th edition. Hearst Books, New York, New York.

Electrofishing Safety

Casey Harthorn

Initial and continual training is an essential element to all electrofishing operations. The U.S. Fish and Wildlife Service (http://training.fws.gov/) and electrofishing equipment manufacturers (http://www.smith-root.com/) provide training on safe electrofishing practices and techniques. All federal agency and many state agency fisheries biologists are required to complete one of these courses before being assigned by management as a crew leader of an electrofishing operation. In addition, Reynolds (1996) wrote a very comprehensive chapter on electrofishing techniques and safety. This chapter is an excellent reference source, and personnel involved in electrofishing operations should periodically review it. Much of the information contained within this Standard Operating Procedure section was synthesized from that chapter. Additional electrical safety information is located on the OSHA web site (http://www.osha.gov/).

Fisheries biologists can become complacent about safety and disregard their common sense. They may not take the time to wear a Personal Floatation Device (PFD) or rubber electrician gloves when conducting electrofishing operations. Some may even believe that because the energy from a backpack electrofisher is coming from a battery that it cannot harm them (if you have ever touched a coil wire you would know better). Unfortunately, a complacent attitude can and does lead to injury and may prove to be fatal. ALL electrofishing operations are dangerous and require fisheries biologists to be cognizant of our safety obligations to ourselves and to others.

The energy generated from batteries or generators used during electrofishing operations is sufficient to injure or kill a person. People have been killed with a current as low as 0.002 amp, a value well below the average 6 amps used during some electrofishing operations. Exposure to a low electrical current may cause death through respiratory arrest or cardiac fibrillation. Cardiopulmonary resuscitation (CPR) may restore breathing for respiratory conditions; however, CPR is not generally effective for overcoming cardiac fibrillation. Because of these dangers, the crew leader and at least one other crewmember must be trained in CPR and Automated External Defibrillator (AED) procedures (see CPR/AED and First Aid Training section). Additionally, all personnel involved in electrofishing operations must know the location of the nearest hospital or medical facility and the procedures for contacting the local EMS. In wilderness areas, the crew leader should brief personnel on radio and cell phone limitations and evacuation strategies.

Electrofishing Methods

There are five common electrofishing methods: boat, bank, skiff, raft, and backpack shocking. The team leader should brief all electrofishing team members regarding the

method they are using, the risks inherent to that specific electrofishing practice, and proper safety procedures. The electrofishing safety and orientation guide (appended) describes most of the hazards. Employee briefings should be documented in writing and maintained in a central file.

The team leader is responsible for the overall welfare of all team members and should strictly enforce all safety procedures. The team leader supervises all aspects of the operation, makes initial settings on the equipment, organizes the crew, and makes all final decisions requiring a judgment call. Individual team members are responsible for knowing and understanding governing policies and complying with all safety procedures.

All electrofishing operations are inherently dangerous; however, bank and skiff shockers require additional precautions. During these operations, people are in the water surrounded by a large and strong electrical field where the slightest mistake could prove to be fatal. Due to these dangers, team leaders should consider other electrofishing methods before initiating bank or skiff shocking operations. If bank and skiff operations are initiated, the team leader must ensure all personal safety equipment, including PFDs, are used and personnel are briefed regarding the possible hazards associated with these specific methods.

Under no circumstances should a person electrofish alone. Likewise, avoid large crew sizes; confusion and miscommunication are more likely to occur with larger groups, thus the crew leader must balance labor needs with efficiency. For standard surveys that use an electrofishing boat, limit crew size to a maximum of four people: two netters, one fish handler, and the boat driver. Larger operations may require an additional fish handler. Operations often use untrained volunteers; in these situations, the team leader will thoroughly brief all volunteers on all aspects of the electrofishing operation.

Boat operators should maintain a first aid kit on the boat, whereas bank and backpack operators should provide a first aid kit close to the project site. AEDs are readily available and should be considered as an integral part of the first aid kit and maintained with the first aid kit. Personnel responsible for maintaining electrofishing boats must maintain a serviceable fire extinguisher (ABC type) mounted in an easily accessible location. Do not mount fire extinguishers near gasoline tanks, generators, or outboard motors. Fire extinguishers should also be available during electrofishing operations that require a gasoline-powered generator or similar power source.

Loud and continuous noise from generators and boat motors are another danger associated with electrofishing operations. Continuous loud noise could damage hearing and it impairs communication among the electrofishing team members. The team leader should provide ear protection for personnel. Additionally, the team leader should inform all personnel involved in electrofishing operations that verbal communication

may not be possible and hand signs may be required. The team leader should brief team members on the use of hand signs during the safety briefing. An alternative form of communication are voice activated radios between the boat operator and netters.

Adverse weather can affect electrofishing operations. If a thunderstorm is in the vicinity, immediately stop all electrofishing operations and get off the water. An electrofishing boat does not draw lightning to it any more than any other recreational vessel on the water. However, there is significant danger to any boat that is on the water during a thunderstorm because the boat and its occupants are the tallest objects on a flat surface. During a rainstorm, electrofishing operations may continue at the discretion of the team leader; however, operations should cease when a continuous sheen of water begins to develop over the equipment. This sheen may provide a path for electricity between the water and occupants of the electrofishing boat.

Avoid electrofishing operations near bystanders, pets, or livestock that are in or near the water. A good rule of thumb is to suspend operations if bystanders or animals are within the immediate area of the electrofishing operation.

Personal equipment and clothing is often a sensitive issue that requires a balance between safety and comfort. However, there is no compromise for some equipment. The following list is an example of those items for which there will be no compromise:

Personal Flotation Device

A Type I or II Personal Flotation Device (PFD) will be worn at all times by all personnel involved in boat, raft, skiff, or bank electrofishing operations. When backpack electrofishing in waters that are over waist deep and are swift, cold, or turbid, the team leader may require personnel to wear PFDs.

Waders and Hip Boots

All crewmembers need to wear chest or hip waders to insulate them from electrical shock. Suitable waders are generally constructed of neoprene, PVC, silicon, etc. All footwear should be equipped with non-slip soles. Breathable, lightweight waders may not have adequate electrical insulating properties—however it is recognized that logistical or climate constraints may necessitate the use of this type of wader. In the event that Gore-Tex type waders are used for electrofishing activities, the following precautions will be followed: operators need to wear dry clothing that covers bare skin within the wader, and breathable waders should not be used when conducting bank or barge shocking operations.

Rubber Gloves

Team leaders should require all electrofishing personnel to wear rubber electrician gloves, preferably gloves with a gauntlet that goes to the elbow. Wear electrician gloves rated at or above the power of the generator (e.g., 5,000 or 7,500 watts) or other power source used.

References

Goodchild G. A. 1986. Electrofishing guidelines and procedures. Ontario Ministry of Natural Resources Policy F1.3.01.01.

Reynolds, J. B. 1996. Electrofishing, Pages 221–253 *in* B. R. Murphy and D. W. Willis, editors, Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Acknowledgment of Electrofishing Orientation

I have received instruction and orientation about electrofishing from my employer. As a result, I understand and accept the following conditions.

1. Electrofishing (EF) is an inherently hazardous activity in which safety is the primary concern. The electrical energy used in EF is sufficient to cause death by electrocution.
2. Personnel involved in an EF operation are prohibited from consuming any alcohol for 4 hours prior to performing EF operations and for 8 hours following an accident or until a post-accident test is conducted. The use of any prescribed drugs should be brought to the attention of the crew leader prior to beginning an EF operation.
3. During operations, it is critical to avoid contact with the electrodes and surrounding water. The EF field is most intense near the electrodes and can extend 5-10 meters outward.
4. The electrodes are energized by the power source, a generator or battery, and controlled by safety switches; these switches must remain off until the signal is given to begin EF.
5. The power source has a main switch that must be turned off immediately if an emergency occurs.
6. The electrodes are usually metal probes suspended in the water. If direct current is used from a boat, the anodes (+) are in front of the boat to catch fish and the cathodes (-) may be suspended from the sides; both can produce electroshock. When a metal boat is the cathode, the boat is safe as long as all metal surfaces inside it are connected to the hull.
7. Moveable anodes on a boat are dangerous, especially on metal boats. All electrodes on a conventional EF boat should be in fixed position during operation.
8. Dry skin and clothing are good protection against electroshock. The body should be fully clothed during EF. Rubber knee boots are minimal foot protection, as are rubber gloves for the hands. A personal flotation device must be worn when the water is considered swift, cold, or deep. Ear protection is necessary for those working near the generator.
9. At least two members of the EF crew must have knowledge of CPR and first aid. A first aid kit and, in an EF boat, a fire extinguisher must be within immediate reach during an operation. Electroshock can cause heart fibrillation or respiratory arrest; CPR can cure only the latter. The EF crew must know the location of the nearest defibrillation unit.
10. A communication system particularly hand signals must be available to all members of an EF crew. When multiple anodes are used in a portable EF operation, the buddy system must be used. Above all NEVER OPERATE ALONE.
11. Stunned fish should be removed from the EF field as soon as possible and not subjected to continuous electroshock by being held in the dip net. Using the anode as a dip net is unhealthy for fish and people and should be avoided.
12. An EF operation should proceed slowly and carefully; avoid chasing fish and other sudden maneuvers. Night activities require bright, bow mounted headlights. Operations should cease during lightning or thunderstorms; use discretion during rain. Avoid EF too close to bystanders and pets or livestock.
13. All EF crewmembers must know who their leader is and recognize his or her authority as final in operational decisions. However, every crewmember has the right and encouraged to ask questions or express concern about any safety aspect of an EF operation. A crewmember has the right to decline participation in an EF operation, without fear of employer recrimination, if he or she feels unsafe in such participation.

_____ _____

Signature of employee Date

I have discussed the above-named conditions with the employee and am satisfied that he or she understands them.

_____ _____

Signature of Supervisor Date

Adapted from: Reynolds, J. B. 1996. Electrofishing. Pages 221-253 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Underwater and Diving Safety

Steve Sellers and Casey Harthhorn

The following section was adopted from the *Standards for Scientific Diving* of the American Academy of Underwater Sciences (AAUS) and Occupational Safety and Health Administration (OSHA) regulations from 29 CFR 1910. AAUS is recognized by OSHA as the scientific diving standard setting organization. The Academy consists of over 100 organizational members including universities, marine labs, government agencies and other groups involved with scientific diving.

The AAUS *Standards for Scientific Diving* is a consensual standards document. It was originally developed and written by compiling the policies set forth in the diving manuals of several universities, and private and governmental scientific diving programs. These organizations share a common heritage with the scientific diving program at the Scripps Institution of Oceanography (SIO). Adherence to the SIO standards has proven both feasible and effective in protecting the health and safety of scientific divers since 1954. The AAUS standards are reviewed regularly to insure they are up to date with the most current diving technologies and practices.

Standards for Scientific Diving sets minimal standards for the establishment of AAUS recognized scientific diving programs, the organization for conducting of these programs, and the basic regulations and procedures for safety in scientific diving operations. It also establishes a framework for reciprocity between AAUS organizational members that adhere to these minimum standards. More information about AAUS is available at http://www.aaus.org. Additional information on safe diving practices can be found at the U S Navy, Navy Safety Center website: (http://www.safetycenter.navy.mil/afloat/diving/default.htm), and from the Divers Alert Network: http://www.diversalertnetwork.org/.

In 1982, OSHA exempted scientific diving from commercial diving regulations, provided certain conditions are met. The complete regulations related to commercial diving and the scientific diving exemption are available under 29CFR1910.401 Subpart T, an abridgement of these requirements is outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol. 50, No.6, p.1046).

Scientific diving is defined as diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks. In the regulations, OSHA granted an exemption from commercial diving regulations for diving "defined as scientific diving and which is under the direction and control of a diving program containing at least the following elements:

A. Diving safety manual which includes at a minimum: procedures covering all diving operations specific to the program; including procedures for emergency

care, recompression and evacuation, and the criteria for diver training and certification.

B. Diving control (safety) board, with the majority of its members being active divers, which shall at a minimum have the authority to: approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify the depths to which a diver has been trained; take disciplinary action for unsafe practices; and, assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for scuba diving."

These regulations outline additional guidelines for the scientific diving exemption:

1. "The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operation.
2. The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
3. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
4. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and therefore, are scientists or scientists-in-training."

The purpose of scientific diving standards is to ensure that all scientific diving is conducted in a manner that will maximize protection of scientific divers from accidental injury and/or illness. The organizations adhering to AAUS *Standards for Scientific Diving* have amassed an outstanding safety record. The OSHA review of diving incidents prior to issuing the scientific diving exemption to commercial diving standards found scientific diving to be safer than banking (Federal Register Vol. 47, No. 228; November 26, 1982; page 53361). AAUS standards are much more in depth than is appropriate for this section. The following is a list of sections for the AAUS *Standards for Scientific Diving*: General Policy, Diving Regulations for Scuba (open circuit, compressed air), Diving Equipment, Entry-Level Training Requirements, Scientific Diver Certification, Medical Standards, Nitrox Diving Guidelines, Aquarium Diving Operations, Staged Decompression Diving, Mixed Gas Diving, Other Diving Technology, Rebreathers, and Scientific Cave and Cavern Diving. Appendices include: Diving Medical Exam Overview for the Examining Physician, Medical Evaluation of Fitness for Scuba Diving Report, Diving Medical History Form, Recommended Physicians with Expertise in Diving Medicine, Definition of Terms, AAUS Request for Diving Reciprocity Form Verification of Diver Training and Experience, Diving Emergency Management Procedures, Dive Computer Guidelines, and AAUS Statistics Collection Criteria and Definitions.

First Aid and CPR/AED Training

Laura Csoboth

Emergency situations can arise in the work environment quickly and often unexpectedly, despite having well-trained and knowledgeable staff and properly enforced health and safety protocols. For aquatic resource professionals who spend considerable time outdoors in extreme conditions, it is critical to understand this risk and take proper precautions to prevent potentially dangerous incidents. Most employers recommend taking a minimum of basic first aid and Cardiopulmonary Resuscitation (CPR)/Automated External Defibrillator (AED) training, but sometimes these recommendations are not adequately enforced.

Aquatic resource professionals working in field situations often find themselves in areas where professional care is not immediately available. Although many emergencies are preventable, unforeseen situations do arise potentially affecting our health and safety as well as our (scientific) fieldwork. Therefore, it is highly recommended that all aquatic resource professionals are made aware of the risks associated with their work and have the requisite skills and experience to handle emergency situations. This section provides information on safety training options, wilderness training options, and the importance of AEDs.

Safety Training Options

Organizations, like the American Red Cross, American Heart Association, and National Safety Council offer a variety of course and training options for non-medical rescue providers. Typically, these training courses prepare individuals for emergency care situations (injury, sudden illness, or cardiac arrest) until professional, medical treatment is available. All of these organizations assume that you are operating under the umbrella of a readily available 911 emergency response system.

There are many online resources that can assist in locating nearby training centers. Course availability and prices vary by region. Typically, combination courses offering first aid, CPR, and automated external defibrillator (AED) training are the most beneficial and economical. Many of the basic courses offered can be completed in one day or less and certifications vary from 1-2 years for the CPR/AED certification and 3 years for the First Aid.

Course	Course Content	Est. Hours Training
Standard First Aid, CPR & AED *[Often meets OSHA requirements]*	Breathing and cardiac emergencies in adults; identifying and caring for bleeding, sudden illnesses, injuries; and preventing disease transmission. Includes an introduction to AEDs.	6-7
First Aid	Identifying and caring for bleeding, sudden illnesses, injuries; and preventing disease transmission.	3-4
Advanced First Aid	Breathing and cardiac emergencies; bleeding and shock, sudden illness, and injuries; special situations; natural disasters.	16-40
CPR & AED	Breathing and cardiac emergencies in adults, children and infants, heart disease prevention, scene assessment, patient assessment, CPR, AED use.	3-4
CPR & AED Refresher	Refresher course for individuals who have previously been certified in CPR and AED operation. Review of CPR, using an AED, and choking for lay rescuers.	2-4

A few options exist for training employees/students. Each option includes instructor observations to ensure participants acquired the requisite knowledge and skills.

- An instructor can come to your facility and train your employees at a time that works for you—daytime, evenings or weekends. Typically, class sizes are 10 individuals, but can be larger if there are multiple instructors.
- One of your employees can become an authorized instructor to provide first aid, CPR and AED training onsite. This cost-effective option allows you to schedule training at your convenience with instructors familiar with your specific emergency procedures and site-specific needs. This option tends to be feasible only for large programs or in those with a high interest level.
- When only a few employees need training, classes are available at community locations.
- The newest and most flexible option allows everyone to learn at their own pace. The Red Cross offers *Blended Learning* training, where the first part of the training is accessed online at the employee's convenience, followed by an instructor-led skills practice and assessment. The American Heart Association offers *CPR Anytime* or *AED Anytime* training, where CPR skills and lessons are taught using a DVD and CD-ROM, followed by an instructor-led skills test.

Automated External Defibrillators (AEDs)

The AED is an electronic medical device that increases the resuscitation rate of patients in cardiac arrest. AEDs are frequently located in public places, including offices and educational institutions. While waiting for the arrival of emergency medical care, immediate defibrillation can be administered with on-site AEDs, increasing survival rates by almost 60% (OSHA 3185-09N 2003).

Aquatic resource professionals are often in situations that make them prone to sudden cardiac arrest, such as electrofishing and working in and around water. In addition to heart attacks, electrocution and asphyxiation (often due to drowning) are the main causes of sudden cardiac arrest.

Because AEDs are compact, portable, and battery-operated, it is possible to store them in many locations. Under current technology, AEDs are not designed to withstand extreme heat/cold or extended exposure to moisture. It is important to note that AEDs should be maintained and operated according to the manufacturer's instructions, which typically require that the victim and rescuer are removed from water and the victim's chest is dry. It is not recommended to bring an AED along in the field or store long-term in a vehicle.

AEDs can check a person's heart rhythm and recognize a rhythm that requires an electrical shock. The device uses voice prompts, lights and/or text messages to tell the rescuer what to do. AEDs are accurate and easy to use, though it is strongly recommended not to operate an AED without proper training.

There are many AED manufacturers, though all units are manufactured and sold under Food and Drug Administration (FDA) guidelines. Prices and minor features vary by brand. All AEDs operate in a similar fashion. No specific brand is advocated for use by OSHA, the American Heart Association, the American Red Cross, or the National Safety Council.

The goal of any AED program is to increase the survival of people who are victims of sudden cardiac arrests. It is strongly encouraged that an AED program be established in every workplace. An AED program can be implemented in any workplace or facility by having a dedicated AED program coordinator, trained users, and following state and national regulations. Program requirements vary by state. The Federal Occupational Health, OSHA, and many American Red Cross chapters offer assistance for those interested in implementing an AED program. Private companies also provide these services. There are also grants available to help defray the cost of implementing your own AED program.

Wilderness Safety Training Options

For aquatic resource professionals that regularly work in remote wilderness settings, it may be beneficial to expand the scope of their first aid and rescue skills.

Remote settings are identified based upon both the miles-from-care, as well as the accessibility of the site. Generally, areas beyond two hours from definitive care are considered remote. Wilderness safety training may also be beneficial for individuals working alone or in small groups that would require administering emergency care for an extended period before professional medical assistance could arrive. The primary hazards associated with working in remote locations are:

- Isolation from public rescue services;
- Limited means of communication;
- Exposure to adverse/severe weather

If extended period of time outside of normal cell coverage areas is expected, it may be prudent to consider purchasing a satellite phone.

Wilderness first aid courses can be found throughout the country (and world), and are typically rigorous, fast-paced, with many hands-on training components. Certifications are typically three years. If you choose to go this route, it is imperative that you go with an industry-recognized training organization. The top three such organizations in the U.S. are: Wilderness Medical Associates, SOLO, and the Wilderness Medicine Institute.

Course	Appropriate for...	Course Content	Est. Hours Training
Wilderness First Aid	People working or leading groups outdoors for short periods of time	Basic skills of response and assessment, musculoskeletal injuries, environmental emergencies, survival skills, soft tissue injuries (trauma), and medical emergencies (critical care, CPR)	16
Advanced Wilderness First Aid	People wanting more information, exposed for long periods, but not acting as first responders	Builds upon basic skills and subjects, emphasizes patient assessment, and presents new survival skills	32

For more information on safety training courses, AEDs, and wilderness training visit:

American Heart Association (www.americanheart.org)
American Red Cross (www.redcross.org)
Citizen CPR Foundation (www.citizencpr.org)
Federal Occupational Health (www.foh.dhhs.gov)
National Safety Council (www.nsc.org)
OSHA (www.osha.gov)
Solo (Stonehearth Open Learning Opportunities) (www.soloschools.com)
Wilderness Medical Associates (www.wildmed.com)
Wilderness Medicine Institute (www.nols.edu/wmi)

Table 1. Typical field and/or fisheries related injuries. Always seek medical attention when afflicted or caring for an afflicted person.

Type of Injury	Injury	Characteristics
Flesh Wounds	Scrapes and Abrasions	Usually does not penetrate skin, slow bleeding
	Cuts	Blood is dark red, flows at a steady pace, can be life-threatening
	Puncture Wounds	Blood is bright red, flows very rapidly. If major artery is punctured, treat immediately
Skeletal	Sprained Joints and Dislocations	Range from aching to severe pain. Dislocations show signs of deformity, swelling, discoloration, pain, inability to move injured area, and can emit a grating sound.
	Broken Bones	Deformity, swelling, discoloration, grating sound, pain, inability to move area, exposed bone in the case of compound fracture
	Head and Neck	Change in consciousness, breathing difficulty, impaired vision, inability to move body part, headache, vomiting, loss of balance, tingling in hands, fingers, feet and/or toes
Toxins, Bites, Stings	Spider Bite (Brown Recluse)	Swollen, painful, and itchy in area of bite. Wound blisters. Wound may develop in a large ulcerated area within hours or days. Severe symptoms include fever, chills, nausea/vomiting, and body rash.
	Spider Bite (Black Widow)	Minimal to sharp pain, followed by redness and swelling at site. Bite may not be painful initially. Severe symptoms include abdominal pain, dizziness, headache, fever, severe cramps, weakness and difficulty breathing.
	Scorpion Bite	Immediate pain, itching, swelling, skin changing color, anxiety, fainting, numbness of tongue, vision problems, diarrhea.
	Tick Bite	Possible rash, tick usually visible. Risk of Lyme's disease.
	Snake Bite	Swelling around bite usually
	Insect Sting	Never pull out stinger. Use edge of credit card or something similar to snag venom sack about skin level.
	Jellyfish Sting	Typically painful, red rashes limited to area of direct contact. Lesions can last days/weeks. Severe stings can cause weakness, headaches, vomiting, fever, chills, muscle spasm, difficulty breathing, possibly shock.
	Stingray Sting	Immediate, excruciating pain, bleeding, wounded area may turn red or blue, nausea, vomiting, fever, chills, muscle cramps, paralysis, fainting.
	Catfish Sting	Severe pain, inflammation at site of sting
Contact Allergies	Poison Ivy, Oak, & Sumac	Redness, itchy skin; red bumps or large oozing blisters; often in streaks or patches
Medical Emergencies	Allergic Reactions	Skin (redness, itching, blistering, hives), lungs (wheezing, tightness, cough, shortness of breath), head (swelling of face, eyelids, lips, tongue, throat), nose (stuffy, runny, sneezing), eyes (red, itchy, swollen, watery), stomach (pain, nausea, vomiting, diarrhea)
	Diabetes	Fatigue, excessive thirst, excessive urination, irritability, blurry vision
	Stroke	Weakness, numbness of face, arm, leg, blurred vision, severe headache/dizziness/confusion
	Cardiac Arrest	No heart beat, unresponsive, not breathing
	Seizures	Person makes a sound followed by abnormal stiffening and jerking of arms and legs.
Environmental Emergencies	Hypothermia	Shivering, numbness, apathy, weakness, loss of consciousness
	Hyperthermia	Heat Exhaustion: cool, moist skin, headache, nausea, weakness, heavy sweating Heat Stroke: red, hot, dry skin, vomiting, loss of consciousness
	Frostbite	Lack of feeling, waxy, cold discolored skin
	Sunburn	Red, dry skin; blisters form when more severe
	Drowning/ Near-Drowning	Coughing, choking, vomiting, shortness of breath/gasping, blue lips/tongue, clenched teeth, frothy sputum, weak pulse, slow absent breath, and coma

Fish Handling Safety

Larry Olmsted

The potential for personal injury and disease from handling fish is one of the greatest, and most underestimated, hazards for fisheries biologists. Hazards include contacting numerous disease-causing organisms; punctures, cuts, or abrasion injuries from fish spines, gill rakers, teeth, or opercula; and secondary infections.

There is an increasing awareness of the diseases that can result from handling of fish, particularly those from polluted or organically enriched waters. The front page of the March 11, 2006 *Washington Post* reported on a myctobacteriosis epidemic in the Chesapeake Bay. The article reported that the disease (also known as fish handler's disease) can cause severe skin infections in humans and had spread to nearly three-quarters of the striped bass in the bay. Fish handler's disease is a skin infection that is not life threatening, but can lead to arthritis-like symptoms if left untreated. If untreated there is some evidence that fish handler's bacteria can lead to much more serious problems, including swollen lymph glands, gangrene, and lung problems.

Fish handler's disease is but one of a myriad of diseases potentially transmitted during the handling or culture of fishes. Roger Rulifson and his students at East Carolina University have prepared a table of examples of occupational diseases potentially hazardous to field biologists, culturists, and laboratory workers (Table 2). Of particular interest are the importance of avoiding polluted areas as much as possible, preventing contamination by wearing gloves and other protective equipment, avoiding punctures and open wounds, and thorough cleansing after exposure in the prevention of these diseases.

Puncture wounds and cuts are often accepted as a "cost of doing business" by biologists working with fish. These wounds can result from spines, gill rakers, opercula, and teeth. Aside from the initial pain from these wounds, the potential for secondary infections make this an unacceptable cost of doing business. Catfish present particular problems because they have glands at the base of their spines that may allow them to envenomate handlers when spines puncture the skin. These envenomations can cause intense pain out of proportion to the physical injury. Often, fish spines break off beneath the skin, and presence of the foreign object may not be obvious to the person. Even if no ray or spine persists in the body, secondary infections can require intense antibiotic treatment.

The potential for significant problems underscores the importance of prevention of fish spine punctures (spining) or other cuts resulting from handling fish. The most effective preventative measure is the use of appropriate gloves. Some field workers prefer nylon gloves, others opt for Kevlar. In both instances, it is imperative for dexterity that the

gloves fit snugly. Gloves offer considerable protection from spining, and essentially eliminate the possibility of nicks and cuts. Field workers who have used appropriate gloves for a period of time would not work without them. If a biologist has open wounds on their hands, they will often wear a pair of latex gloves beneath the outer gloves to provide an additional layer of protection against pathogens and infections.

Several other actions may reduce incidence of injuries. Catfish collected in gill nets present particular challenges. If spines are not being saved for aging, the biologist may use a pair of wire cutters to cut the spines off the catfish while they are still in the gill net. This facilitates removal of the fish from the net, and may ultimately lead to less stress on the fish. Use of appropriate tools such as a hooked picking tool allows the worker to remove netting more efficiently and minimize contact with spines.

Biologists should not take lightly wounds sustained from handling fish. As soon as possible the wound should be disinfected and bandaged. The wound can be disinfected with alcohol, bacitracin, Neosporin, or any other topical antibiotic ointment. Pain from wounds can be alleviated with acetaminophen or ibuprofen. In addition to first aid kits, sampling crews can prepare their own specialized fish handling kit including betadine, alcohol, towelettes, and a small scrub brush to wash and disinfect hands after handing fish. Similar kits should be standard equipment for all fish sampling crews.

Puncture wounds to joints should receive particular attention because they are especially susceptible to infection. At the first sign of infection, the individual should seek immediate medical attention. Signs of infection are ascending red marks, increased pain and soreness in joint areas or above the sting area. There may be a fragment of spine that needs to be surgically removed. Oral antibiotics are often prescribed to treat the infection and may help prevent progression to cellulitis. It is even more important to use sunscreen while taking antibiotics because certain antibiotics may cause sensitivity to the sun.

Table 2. Examples of occupational diseases potentially hazardous to field biologists, culturists, and lab workers.

Name	Other names	Pathogen	Carrier	How transmitted	Appearance on host	Human symptoms	Prevention
Vibriosis		*Vibrio parahaemolyticus; V. vulnificus; V. alginolyticus*	shellfish,. Crustaceans	cuts, open wounds, ingestion	not visible	acute diarrhea, abdominal cramps, fever, soft tissue destruction	protective foot and hand gear, avoid eating raw or undercooked shellfish and crustaceans
Diphyllobothriasis	tapeworm	*Diphyllobothriasis pacificum; D. latum*	intermediate hosts planktonic crustaceans, freshwater fish; final hosts dogs, cats, humans	ingestion of contaminated water, food, particles	intestinal, may be visible at anal opening	diarrhea, intestinal blocking, vitamin B-12 deficiency	drink only boiled water, fully cook all fish meat, dispose of pet feces hygienically
Human edwardsiellosis	edwardsiella	*Edwardsiella tarda*	fish especially ornamentals and catfishes, reptiles, other ectotherms	ingestion of fecal contaminated food	not visible	gastroenteritis, intestinal distress similar to that of Salmonella poisoning	wash with good antibacterial soap after cleaning ponds and tanks
Melioidosis		*Burkholderia pseudomallei*	contaminated aquarium water	water inhalation; ingestion; water contact with skin wounds	not visible	similar to typhoid fever or TB; pulmonary cavitation; chronic abscesses	avoid contact; dispose of aquarium wastewater appropriately

Table 2. Continued.

Name	Other names	Pathogen	Carrier	How transmitted	Appearance on host	Human symptoms	Prevention
Erysipeloid or Erythema migrans	fish handler's disease, fish poisoning, fish hand, sealer's finger, whale finger, blubber finger, diamond skin disease	*Erysipelothrix rhusiopathiae*	fish, shellfish, marine mammals; also domestic pigs and nursing sows	handling infected organisms or fecal waste with open wounds		elevated lesions on skin (can be diamond-shaped), joint pain, fever, severe headaches; incubation 1-7 days	use gloves when handling
Crayfish Handlers Disease	Sealer's finger	*Erysipelothrix insidiosa, species of Vibrio*	fish and shellfish	handling infected organisms with open wounds or abrasions	not visible	painful itching or burning; joint swelling, stiffness; lasts up to 3 weeks	use gloves when handling, thick boots when wading
Fish TB	fish tank granuloma, swimming pool granuloma, tuberculosis, mycobacteriosis	*Mycobacterium marinum*	fish	handling fish or cleaning infected tank with open wounds		skin, soft tissue destruction; small purple lesions that gradually enlarge; incubation period 2 weeks-2 years; can mimic carpal tunnel syndrome	use gloves or other protective gear; avoid punctures or handling with open wounds

Table 2. Continued.

Name	Other names	Pathogen	Carrier	How transmitted	Appearance on host	Human symptoms	Prevention
Salmonellosis	Salmonella	*Salmonella sandiego, S. java, S. pomona, S. miami*	turtles, newts, frogs, toads, other reptiles and amphibians	direct contact and indirect (unwashed clothes); exposure to contaminated aquarium water	not visible	diarrhea, abdominal cramping, fever	wash hands and clothes after handling
Avian cholera		*Pasteurella multocida*	ducks, geese, coots, gulls, crows	direct contact with feces, secretions of infected birds, water and aerosols (e.g., fountains, air-borne particles)	not visible	diarrhea, vomiting, dehydration	wear gloves when handling; avoid areas of huge die-offs or aerosols from carcass burning
Swimmer's Itch		*Schistosome cercarial dermatitis* (12-15 species)	waterfowl and humans -- adult phase; aquatic snails - intermediate	swimming or contact with waters infested with the flatworm		skin rashes and bumps (papulae) within 30 min of exposure	avoid waters with known outbreaks, prevalent waterfowl, or aquatic snail populations
Giardiasis		*Giardia intestinalis*	infected soil and water; surfaces contaminated with animal or human feces	accidental ingestion	not visible	diarrhea and dehydration	avoid contaminated soil, water, food, fecal exposure

Table 2. Continued.

Name	Other names	Pathogen	Carrier	How transmitted	Appearance on host	Human symptoms	Prevention
Cryptococcosis		*Cryptococcus neoformans*	wild birds	inhalation of airborne powdery bird droppings	not visible	serious brain and spinal cord disease, headaches, dizziness, sleepiness, confusion	avoid high risk areas with high concentrations of bird droppings
Tularemia		*Francisella tularensis*	handling muskrats, bull snakes, others; eating wild meat such as rabbit or rodents	handling infected animals, even with unbroken skin	not visible	fever, headache, nausea immediate; local lesions grow and ulcerate; ingestion causes enteritis, stupor, and delirium	wear impervious gloves when handling; cook meat thoroughly; avoid bites of flies, mosquitoes, and ticks in endemic areas; do not bathe or drink in untreated water
Newcastle Disease		viruses of family Paramyxoviridae	wild and domesticated birds	inhalation of infectious aerosols; also contact on inanimate objects and airborne between poultry houses	not visible	painful conjunctivitis, fever, influenza-like symptoms for up to 3 weeks	wear gloves when handling birds; avoid endemic areas

Table 2. Concluded.

Name	**Other names**	**Pathogen**	**Carrier**	**How transmitted**	**Appearance on host**	**Human symptoms**	**Prevention**
Hemorrhagic Disease		*Aeromonas hydrophilia*	warm water fish in southern areas stressed, traumatized, overcrowded or in low dissolved oxygen	handling infected organisms	can be externally visible	diarrhea, infections on skin, eye, other organs	
Red Plague		*Aeromonas salmonicida*	wild and captive freshwater fish	handling infected fish		diarrhea, skin infections	

Chemical Application and Hazardous Waste Safety

Dennis Riecke and Fred Heitman

Chemical Application

At some point in their career most fisheries management and fish hatchery workers will be using chemicals to control aquatic plants, treat fish diseases, eradicate fish populations or sample fish populations. Pesticide is a general term referring to chemicals used to destroy, prevent or control pests. Pests may include diseases, insects, and weeds. The term pesticide also refers to chemicals that regulate plant growth and remove or coat leaves. Pesticides include fungicides, herbicides, rodenticides, insecticides or piscicides.

There are benefits and risks associated with pesticide use. Agricultural production has increased as pesticide use has allowed farmers and ranchers to control pests such as insects, diseases and weeds. Public health has improved from the control of nuisance pests and disease vectors such as mosquitoes. Pesticide use has greatly improved our quality of life. However, because there are significant risks to the environment, domestic animals, wildlife, fish and humans from the manufacture, storage, use and disposal of pesticides they are highly regulated by federal and state agencies.

Pesticides cannot be sold in the United States unless the US Environmental Protection Agency has reviewed the manufacturer's application for registration and found that use of the product does not result in an unreasonable risk to the environment or humans (MCES 1991). The Federal Insecticide, Fungicide, and Rodenticide Act of 1972 established chemical applicator training to minimize these risks. Federal regulations establish general and specific standards that individuals must meet before they can use certain pesticides.

A good starting point for learning about state programs providing pesticide safety training is http://pep.wsu.edu/psp/scripts/menu.asp. This website has links to state-specific websites and a list of state pesticide applicator education/certification websites. You should contact your state Cooperative Extension Service or the USEPS website http://www.epa.gov/oppfead1/safety/applicators/statepro.htm to determine which agency to contact to become a certified pesticide applicator.

Hazardous Waste

There are instances where fisheries biologists can be exposed or potentially exposed to chemicals and/or situations that may pose a threat to the health and safety of the individual. If not properly trained and equipped, the safety and even the life of the individual may be in danger should they proceed into an affected area. For example,

fisheries biologists commonly investigate fish kills. In fact, they often are a first responder to these events. Usually fish kills are related to low dissolved oxygen, and that may be what killed the fish. However, the cause of the low dissolved oxygen should be considered first. If the low dissolved oxygen is the result of chemical pollution, then it is in the best interest of the individual to NOT INVESTIGATE the kill. Instead, a supervisor or state emergency response agency should be contacted.

Federal regulations require training for people who are exposed or POTENTIALLY may be exposed to certain chemicals. Often these are the chemicals that cause fish kills or result in other environmental perturbations. Some states have teams of specially trained fisheries biologists that assess fish kills, whereas in other states these individuals reside in agencies other than the fish and wildlife agency.

In general, persons with the special training to investigate chemical spill incidents have completed a 40-hour OSHA Hazardous Waste General Site Worker Course. This course teaches them how to deal with a wide range of emergency situations. To renew this certification, an eight-hour refresher course is required annually as well as a medical checkup to ensure that you are physically capable of withstanding the rigors of working under the stressful and difficult conditions.

The Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) applies to five distinct groups of employers and their employees. This includes any employees who are exposed or potentially exposed to hazardous substances -- including hazardous waste -- and who are engaged in one of the following operations:

- Clean-up operations -- required by a governmental body, whether federal, state, local, or other involving hazardous substances -- that are conducted at uncontrolled hazardous waste sites;
- Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq.);
- Voluntary clean-up operations at sites recognized by federal, state, local, or other governmental body as uncontrolled hazardous waste sites;
- Operations involving hazardous wastes that are conducted at treatment, storage, and disposal facilities regulated by Title 40 Code of Federal Regulations Parts 264 and 265 pursuant to RCRA, or by agencies under agreement with U.S. Environmental Protection Agency to implement RCRA regulations; and
- Emergency response operations for releases of, or substantial threats of releases of, hazardous substances regardless of the location of the hazard.

Information about HAZWOPER, including frequently asked questions, can be found at http://www.osha.gov/html/faq-hazwoper.html.

Identify your HAZWOPER state contact if you suspect that chemicals may be a source of a fish kill or aquatic pollution. DO NOT enter the area. Leave that to the trained individuals.

Employers are responsible for informing their employees of the hazards of pesticides present at the work site. One of the ways this can be accomplished is through the use of a Hazard Communication Standard (HSC) program. A written HSC program helps employers educate and inform their employees on the chemicals used in their workplace and what proactive measures they can take to prevent adverse affects from occurring. The goal of these programs is to create and maintain safe work environments. The HCS mandates:

- Each employer will conduct a hazard assessment for each chemical used in the workplace.
- A list of chemicals used in the workplace is to be made available to the employees.
- A Material Safety Data Sheet (MSDS) is made available for each chemical in the workplace.
- The employer is to adopt a labeling program for each chemical used in the workplace.
- The employer is to demonstrate that all employees are trained on the HCS including the MSDS.
- Each employer is to provide a written program describing this HCS. The written program is to be available to all employees.

Employers are required by OSHA to make Material Safety Data Sheets (MSDS) available to their employees. The MSDS provide information on hazardous chemicals and are available from pesticide distributors. MSDS can also be found at www.greenbook.net and www.cdms.net.

The intent of this section is to provide the most basic information on chemical application and hazardous waste safety and resources to consult for specific information. It is the responsibility of the employer and employee to provide and receive training. Read and follow label directions.

References and Resources

MCES (Mississippi Cooperative Extensive Service). 1991. Applying pesticides correctly: a guide for private and commercial applicators in Mississippi. Mississippi Cooperative Extension Service, Mississippi State, Mississippi.

Pennsylvania State University. 2003. What you need to know about reading a pesticide label. http://pubs.cas.psu.edu/FreePubs/pdfs/uo215.pdf

Occupational Safety and Health Administration http://www.osha.gov

National Poison Center Hotline at 1-800-222-1222.

Chemical Transportation Emergency Center at 1-800-424-9300.

Laboratory Safety

Roger Rulifson

Fisheries biologists work under a variety of “laboratory” conditions, from the top of an ice chest or seat of a skiff, to a storage shed, to an academic setting complete with the best equipment and operated under the requirements of the Occupational Safety and Health Administration (OSHA) and an institutional Animal Care and Use Committee. But there is a commonality to these various settings, and that is laboratory safety. Knowing the hazards of chemicals typically used, and using common sense in bench-based procedures, is two-thirds of the battle (Table 3). Researchers working by themselves or in a remote office may be able to get away with occasional mishaps, but in industry, state and federal agencies, and academia, mistakes must be reported and if not, they could result in citations, fines, or suspension or termination of programs. Workers’ compensation for work-related injuries could come out of your research grant or your field budget and you may lose an important field crew member for an indeterminate period. Safety must come first!

In 1990, OSHA promulgated 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories, to provide guidelines for the safe use of chemicals in laboratories. This standard is applicable in locations where “laboratory use” of hazardous chemicals occurs: 1) work involves containers easily and safely manipulated by one person, 2) multiple chemicals or chemical procedures are used, and 3) protective lab practices and equipment are available to minimize exposure to the chemicals. Fisheries biologists surely fit into the first two categories, but sadly, few of us worry about the third. It is one thing to be provided the protective gear required for safe lab procedures and not use it, than to never be issued the gear in the first place. Supervisors take note: you can be held personally liable if you do not provide the appropriate gear for employees. This is similar to employees not being issued life jackets for a work boat even though they are required. Someone drowns and the supervisor is personally liable.

OSHA requires an entity, whether an industry, agency or academic institution, to develop and implement a chemical safety plan. Following are topic areas that should be considered in developing this plan.

- Prepare, implement, and maintain a written chemical hygiene plan to protect workers and the workplace from exposure and contamination.
- Provide training that includes hazard identification and control measures, accident reporting procedures, waste handling/storage, spill procedures, and individual responsibilities.
- Provide employees with chemical hygiene training on a scheduled basis, or on request.
- Maintain a master list of all chemicals stored in the laboratory.

- Maintain a master file of the Material Safety Data Sheets (MSDS) of all chemicals stored in the laboratory.
- Maintain a master emergency contact list in the case of spills or fire. Also on that list should be the names and contact information for all employees designated to work in that particular laboratory. Keep this list posted in the lab, and put the information on the outer door of the lab so that emergency personnel can access the information after hours.
- Require annual lab inspections, but monthly inspections may serve to keep the workplace cleaner and chemicals stored in the proper place. Some organizations (e.g., OSHA, EPA) require routine weekly inspections of emergency equipment and housekeeping of hazardous waste storage areas.
- Ensure that all chemical containers are properly labeled and stored.
- Provide appropriate protective clothing and equipment. This may include laboratory coats, protective gloves and eyewear, and respirators. Lab coats or full-length shirts and pants are required to minimize chemical exposure and burns. Full-toed shoes (not flip-flops or sandals) must be worn in the lab.
- Do not allow food or beverage in the laboratory. Coffee pots and food storage (lunchboxes, vending machines) must be separated by a wall from the laboratory.
- Do not allow smoking and application of cosmetics in the laboratory.
- Provide adequate ventilation of the laboratory to minimize concentrations of chemicals in the air.
- Chemical fire extinguishers should be provided, and employees should be trained on how to use them effectively.

Disposal of chemical waste is always a difficult task at best unless there is a mechanism in place to deal with the problem effectively. Fisheries biologists commonly use known carcinogens such as formalin or formaldehyde. These chemicals should NOT be flushed down the sink untreated. Our municipal wastewater treatment facility requires that formalin be mixed with any cheap-grade chlorine bleach to form a precipitate to tie up the formalin. Chemical wastes should not be mixed; each chemical requires its own container. Label the container with the waste and mark it with the date when waste was first put into the container.

Hazardous waste identification, storage, and disposal is covered under the U S Environmental Protection Agency (EPA), Resource Conservation and Recovery Act (RCRA). This act gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. Waste must be stored in secondary containment and labeled Satellite Accumulation Area.

A good reference book that generally incorporates regulations and best practices is *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals* http://www.nap.edu/catalog.php?record_id=4911.

Table 3. Chemicals commonly used by fishery biologists in fieldwork, aquaculture, and laboratory settings.

Chemical	Trade Name	Composition	CAS#	Potential Hazard(s)	Preventative Maintenance
Formaldehyde, 37% Solution	Formalin	Formaldehyde, methanol, water	50-00-0 67-56-1 7732-18-5	Carcinogen, combustible, do not expose to eyes or skin, do not inhale or swallow	Ventilation, protective clothing, no open flames, eye protection, face protection (mask)
Rotenone	Rotenone	1,2,12,12a-Tetrahydro-8,9-dimethoxy-2-(1-methyl-ethenyl)-[1]benzopyrano [3,4-b]furo[2,3-h][1] benzopyran-6(6aH)-one	83-79-4	Toxic if swallowed or absorbed through skin. Causes reproductive and fetal effects.	Prevent contact with skin and eyes, prevent inhalation, ingestion
Potassium Permanganate		Permanganic acid, potassium salt	7722-64-7	Highly combustible, flammable. Do not expose to eyes, skin. Do not inhale, ingest. Strong oxidizer. Corrosive.	Ventilation, protective clothing, no open flames, eye protection, face protection (mask), no smoking, eating or drinking during work
Copper Sulfate	Copper Sulfate		7758-98-7	Irritating gas and fumes. Do not expose to eyes, skin. Do not inhale, ingest. Corrosive. Toxic. Severe marine pollutant.	Ventilation, protective clothing, eye protection, face protection (mask), no smoking, eating or drinking during work
Tricaine methanesulfonate	MS222	3-aminobenzoic acid ethyl ester methanesulfonate	886-86-2	Corrosive. Sensitizer.	Wear appropriate chemical resistant clothing, eye protection. Combustible.
Quinaldine	Quinaldine	2-methylquinoline	91-63-4	Dissolved in ethanol, acetone or water. Solvents can be irritated when used	

				in the field. Combustible liquid and vapor. Harmful if absorbed through skin.	
Quinate	Quinate	Quinaldine sulfate	655-76-5	Dissolved in ethanol, acetone or water. Solvents can be irritated when used in the field. May be absorbed through skin. Irritant. Harmful if swallowed or inhaled. Combustible.	Provide adequate ventilation. Wear appropriate chemical resistant clothing, eye protection.
Carbon Dioxide	Carbon Dioxide	Carbon, oxygen	124-38-9	Typically bubbled in water but difficult to control May cause nausea and respiratory problems. Displaces oxygen; may cause asphyxia.	Provide adequate ventilation. Accumulates in low areas.
AQUI-S	AQUI-S	Isoeugenol (2-methoxy-4-propenylphenol)	97-54-1	Not yet approved by FDA but under review May be harmful if swallowed. Irritant.	Provide adequate ventilation. Wear appropriate chemical resistant clothing, eye protection.
Eugenol	Eugenol	4-allyl-2-methoxy-phenol(active compound clove oil)	97-53-0	US FDA rated not GRAS(Generally Recognized as Safe)Irritant. May cause allergic skin reaction.	Appropriate ventilation, chemical protective gloves/clothing, safety eyewear
Malachite Green	Benzaldehyde Green	Benzaldehyde Green	13425-25-7?? 569-64-2	Respiratory poison, carcinogen. Do not expose to eyes, skin. Do not inhale,	Ventilation, wear gloves, face protection (mask), eye protection

				ingest. Toxic, harmful if inhaled or absorbed through skin.	
Methylene blue		3,7-Bis(Dimethylamino)phenothiazine-5-lum-Chloride	7220-79-3	Powerful dye. May cause skin irritation. Do not expose to eyes, skin. Do not inhale, ingest. Causes methemoglobinemia.	Ventilation, wear gloves, face protection (mask), eye protection
Metronidazole	Flagyl		443-48-1	Cancer suspect agent. May cause CNS effects and liver damage.	Store at room temperature away from moisture and heat. Provide adequate ventilation and protective clothing/eyewear.
Nalidixic Acid Mono Sodium Hydrate		Nalidixic acid	389-08-2	Harmful if swallowed. May cause allergic reaction if inhaled or skin contact. May cause reproductive effects.	Provide adequate ventilation and protective clothing/eyewear.
Nitrofuracin Green		nitrofurazone, furazlidone, methylene blue and salt	59-87-0, 67-45-8, 61-73-4	Toxic. May cause sensitization with skin contact.	Handle with care Provide adequate ventilation and protective clothing/eyewear.
Nitrofurazone powder		5-Nitro-2-furaldehyde Semicarbazone	59-87-0	Harmful if swallowed. May cause sensitization with skin contact. Irritant.	Handle with care Provide adequate ventilation and protective clothing/eyewear.

Oxolinic Acid powder	OXA	INOXYL 24% premix	14698-29-4	Do not administer with compounds containing oxytetracycline, other tetracyclines, nitrofurans, and sulfonamides Harmful if swallowed. Irritant.	Do not administer with compounds containing oxytetracycline, other tetracyclines, nitrofurans, and sulfonamides
Oxytetracycline Hydrochloride	OXYSOL-220	Oxytetracycline HCl	2058-46-0	Treated lobsters must not be used as food for at least 30 days after last treatment Irritant. May cause reproductive effects.	Store at room temperature away from moisture and heat Provide adequate ventilation and protective clothing/eyewear.
Paracide Green		Formalin, p,p benzylidene-N,N, dimethylanaline	50-00-0, 569-64-2, 7732-18-5	Harmful if absorbed through the skin or if swallowed. May cause allergic skin or respiratory reaction. May cause corneal damage.	Prevent contact with skin and eyes, prevent inhalation, ingestion Provide adequate ventilation and protective clothing/eyewear.
Povidone	Povidone K-90		9003-39-8	Irritant	Provide adequate ventilation and protective clothing/eyewear.
Sodium Bisulfate		Sodium Acid Sulfate	10034-88-5	Poisonous. Corrosive.	Prevent contact with skin and eyes, prevent inhalation, ingestion
Sodium Monophosphate			13472-35-0	Irritant	
Sodium Thiosulfate Crystals	Hypo	Sodium Thiosulfate	10102-17-7	Irritant	Absorbs moisture from air.
Sulfathiazole Sodium powder	Sulfa 4 TMP Powder Sodium Sulfathiazole	Sulfathiazole Sodium	144-74-1	Irritant. May be absorbed through intact skin.	Provide adequate ventilation and protective clothing/eyewear.

Tetracycline Hydrochloride	Tranquil Tranquil II Triple Sulfa Powder		64-75-5	Irritant. May cause allergic reaction (skin and inhalation). May cause reproductive effects.	Moisture sensitive. Provide adequate ventilation and protective clothing/eyewear.
Trimethoprim and sulfadiazine powder	TRIBRISSEN 40% POWDER	Trimethoprim, sulfadiazine powder	738-70-5, 68-35-9	Treated fish must not be used as stocker or food in less than 80 days of last treatment Toxic. Rapidly absorbed through GI tract. May cause skin rash and sensitization.	Store at room temperature away from moisture and heat Provide adequate protective clothing/eyewear.
Trimethoprim and Sulfathiazole Sodium	TMP-Sulfa Acriflavine Neutral Powder		738-70-5 72-14-0	May cause sensitization by inhalation and skin contact. Irritant. May cause blood and bone marrow damage.	Sensitive to light. Provide adequate ventilation and protective clothing/eyewear
Amoxicillin			26787-78-0 61336-70-7	May cause sensitization by inhalation and skin contact. Irritant. May cause reproductive effects.	Provide adequate ventilation and protective clothing/eyewear

Chemical	Trade Name	Composition	CAS#	Potential Hazard(s)	Preventative Maintenance
Benzalkonium Chloride 50% Concentrate	Benzalkonium Chloride Solution	Benzalkonium Chloride 50% Concentrate	8001-54-5	Corrosive. Toxic. Very toxic to aquatic organisms.	Provide adequate ventilation and protective clothing/eyewear.
Copper Sulfate Pentahydrate	Crystal Blue De-Los		7758-99-8	Corrosive. Toxic. Severe marine pollutant.	Provide adequate ventilation and protective clothing/eyewear.
ethylene diamine tetra acidic acid	E.D.T.A.		60-00-4	Toxic. Corrosive. Combustible liquid. May cause reproductive effects and kidney damage.	Provide adequate ventilation and protective clothing/eyewear.
Erythromycin	GALLIMYCIN 200	Erythromycin	114-07-8	Milk taken from animals before 72 hours of last treatment must not be used as food Irritant. May cause allergic respiratory and skin reaction	Thoroughly clean and sterilize needles before usage. Prevent contamination of bottle. Provide adequate ventilation and protective clothing/eyewear.
Erythromycin Phosphate Powder	GALLIMYCIN PFC	Erythromycin	4501-00-2	Treated animals must not be slaughtered as food before 24 hours of last treatment. Bird used as egg producing must not be used as food. Irritant. Irritant. May cause allergic respiratory and skin reaction, liver damage, reproductive and CNS effects, hearing loss.	Store at room temperature away from moisture and heat. Do not use if solution is more than 3 days old Provide adequate ventilation and protective clothing/eyewear

Furazolidone Powder	Furazolidone	Furazolidone	67-45-8	Toxic by inhalation, ingestion and skin contact. Irritant.	Provide adequate ventilation and protective clothing/eyewear
Gentamycin Sulfate Powder			1405-41-0	Irritant. May cause allergic respiratory and skin reaction, kidney damage, reproductive effects, hearing loss.	Provide adequate ventilation and protective clothing/eyewear.
Isoniazid	Isoniazid	Iso-Nicotinic Acid Hydrazide	54-85-3	Cancer suspect agent. May be harmful if swallowed.	Provide adequate ventilation and protective clothing/eyewear.
Kanamycin Sulfate Powder			25389-94-0	Irritant. May cause allergic respiratory and skin reaction, kidney damage, reproductive effects, hearing loss.	Provide adequate ventilation and protective clothing/eyewear.
Aquaflor	Florfenicol 50% Medicated Premix	Florfenicol 50% Medicated Premix, lactose, povidone	73231-34-2, 63-42-3, 9003-39-8	Treated animals must not be used as food for at least 55 days after last treatment May cause allergic reactions, gastrointestinal and reproductive effects. May cause long-term adverse effects in aquatic environments.	Store in dry place (2-30^{o}C). Provide adequate ventilation and protective clothing/eyewear.

Chemical	Trade Name	Composition	CAS#	Potential Hazard(s)	Preventative Maintenance
ROMET-30	ROMET-30	Sulphadimethoxine, Ormetoprim	122-11-2, 6981-18-6	Treated fish must not be used as stocker or food in less than 42 days of last treatment if water is above 10^{o}C May cause allergic reactions and birth defects.	Provide adequate ventilation and protective clothing/eyewear.
SALMOSAN 50WP	SALMOSAN 50WP	Azamethiphos	35575-96-3	Use Extreme Caution! Irritant. Harmful if absorbed through the skin. Toxic if swallowed.	Ventilation, protective clothing, no open flames, eye protection, face protection (mask), no smoking, eating or drinking during work