1 INTRODUCTION

The purpose of the *Encyclopedia of Underwater Investigation* is to remove the mystique from underwater investigative procedures and to supply a clear, descriptive, step-by-step instruction manual for the professional public safety dive team.

The public safety diver (PSD) is often called upon as an investigative arm of the police, fire department, medical examiner, or coroner extended to an underwater environment. How you fill this need as a professional investigator will depend on your desire to become part of a growing profession and on how well you prepare yourself by extending your PSD skills to include investigative knowledge.

Underwater investigation of accidents, fatalities, and crime scenes has advanced rapidly in the past decade. Unfortunately, active dive teams have gained much knowledge and education only through trial and error on the job. This method of learning has often evolved into a "trial by fire," where mistakes have been made, and both the investigating agency and the dive team's professional reputation have been compromised in the eyes of the courts and the public, in some cases endangering the lives of team members as well.

While at first glance this manual may seem to be directed toward public safety dive teams, its value to any police, fire department, attorney, or medical examiner's or coroner's office will be apparent. Never before has all this information been assembled into one manual.

INFORMATION BASE

While some aspects of this manual may be included in other specialized texts (medical journals, etc.), most information presented herein is a direct result of actual underwater recovery operations. This manual is a compilation of more than 500 underwater recovery investigations. This broad information base has not only ensured a high degree of accuracy, but it also provides detailed information and facts never before published; in short, this is an accurate, "no-holds-barred," court-ready reference manual for the investigator.

The value of this manual is twofold. First, it explains both the basic and complex details of underwater investigative procedures, so proper actions may be taken and critical errors avoided. In this light, it is truly a *vade mecum* (a handbook to be carried on-site) for the investigator. Second, after evidence is recovered and a crime or accident is being reconstructed for either criminal or civil court proceedings, this manual can serve as a ready reference for presenting yourself in court as an expert witness.

The applications of procedures explained in this manual have no boundaries. The techniques and principles set forth will hold true in all countries and all bodies of water. Careful consideration has been given in the preparation of this manual to utilize only laws that apply across all boundaries: the laws of physics, physiology, and science.

Dive Rescue International Inc. has led the world for more than a decade in the field of public safety diving. This manual is merely one more tool that will assist you and your dive team to be experts in your profession.

Note: When a person referred to in the text may be male or female, the pronoun "he" will be used for convenience; this should not be construed to mean that the person is necessarily male.

In addition, throughout the remainder of this text, when we speak of "coroners" or "coroners' offices," by extension we are including medical examiners, their offices, or any similar officials and official bodies that have comparable duties.

such as gunshot, heart attack, stabbing, or drowning. Ask yourself *what* happened to lead to the decedent's death.

The manner of death directly relates to five areas that include natural, suicide, homicide, accident, or undetermined. Ask yourself *why* did this death come to be?

The mechanism of death ties together both the cause and manner. For example, in the case of a stabbing, the stab would result in blood loss (hemorrhage). Ask yourself *how* this death occurred. Another example might be drowning (cause of death), and the mechanism would be suffocation due to anoxia. It is worth noting that during the postmortem examinations there may be several mechanisms related to cause of death.

Postmortem Physiology — What Is It?

Postmortem (after-death) physiology (the science of the function and phenomena of living things) seems to be a contradiction in terms. It is not. Death in and of itself cannot be covered by one simple definition. Indeed, after the irreversible phenomenon referred to as the death of a person occurs, many organs and tissues in a human body continue to live, if for only a few minutes or hours.

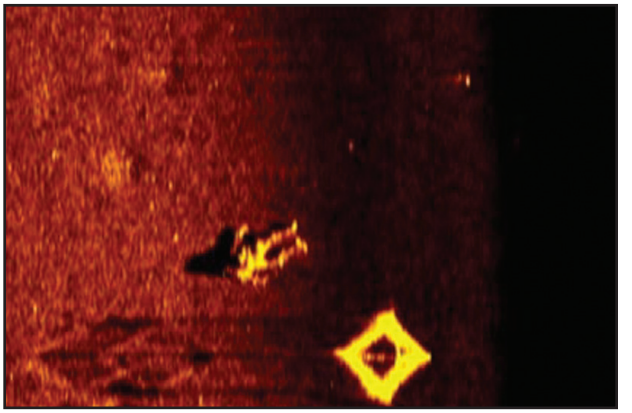
When cellular death is complete, other organisms within the body multiply and feed on the tissues. This function is the natural process of decay. The breakdown of the human body after death is merely a recycling of its vital nutrients back into the biosphere. In death, the human body becomes an ever-changing environment for a variety of biochemical and biological changes.

In effect, the human body without spirit or life of its own becomes one that is once again "alive." Because of these various life-forms, most of which are microscopic, the term *physiology* is indeed accurate.

Postmortem Physiology — Its Importance

The study of this subject encompasses not only the changes that take place in the body but also the very nature of the body itself.

For the purpose of this manual, the emphasis is on studying postmortem physiology as it relates to an aquatic environment. Many of the principles, however, are universal.



Side scan sonar can provide an image of a sunken object even in low or no visibility conditions. It is particularly useful in searching large areas of flat bottom (like lakes). Using side scan sonar might take hours, where using divers might take days or weeks to do the same thing..

A thorough working knowledge of postmortem physiology will assist the investigator in many areas, including locating the drowning victim, ascertaining the cause and time of death, and writing a complete court-ready investigative report, the hallmark of a professional.

Postmortem Physiology and Locating the Body

Whenever a body is submerged in water, whether it was an accidental drowning, suicide, or a homicide, the first stage of the investigation must be a search for the body. With the advent of sophisticated electronic equipment, successful searches for even the unwitnessed drowning victim are becoming more common. These sophisticated devices include remotely operated vehicles (ROVs), side-scan sonar, and sector-scan sonar.

ROVs are vehicles that can be guided from the surface using a joystick or other control devices. They typically have integrated video cameras, so the operator can observe the vicinity in which the ROV is in operation. Most have depth sensors, compasses, and thermometers. Some have graspers, claws, or mechanical arms that be used to recover evidence. One advantage of using an ROV is that a victim can often be located before deploying a public safety dive team, increasing efficiency and reducing risk. ROVs range in size from that of a shoe box to units weighing several tons. Operational depths vary but may be as deep as thousands of feet (meters). ROVs are becoming more sophisticated but have limitations. Public safety teams

Magnetometers

Instruments such as proton magnetometers are often used to locate shipwrecks, land vehicles, etc. The principle they operate on is one that involves sensing and measuring the change in the earth's magnetic field due to the presence of iron. Since aircraft are made chiefly of aluminum and nonferrous (noniron) alloys, magnetometers are usually of limited or no value in locating air-crash sites.

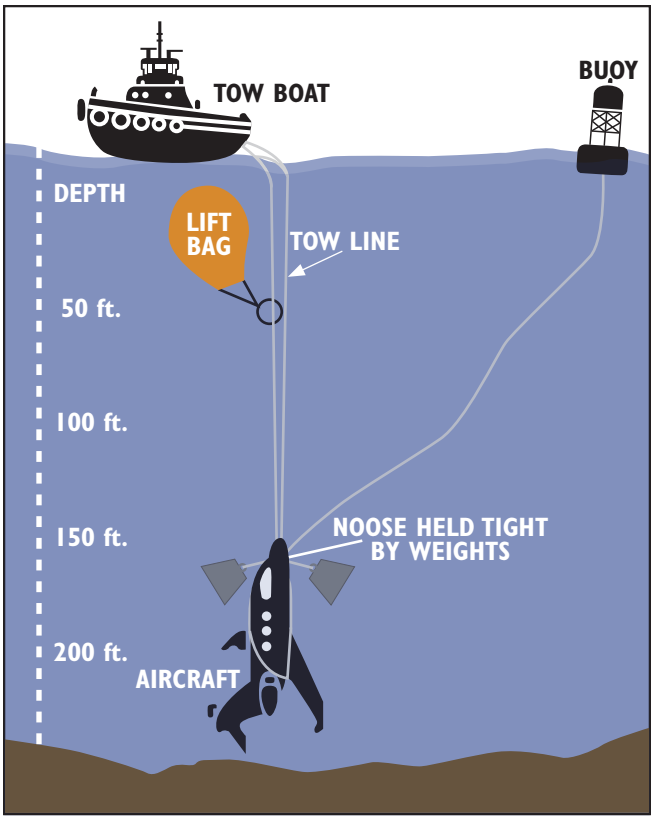
Sonar

Advanced technology has made sonar a valuable tool. As with any scientific instrument, its use depends on the skill of the operator and the capabilities of the instrument. Sonar schools are conducted primarily for public safety dive teams desiring to acquire capabilities that could be considered the industry standard. The investment of time and money into the use of sonar should be very seriously considered.

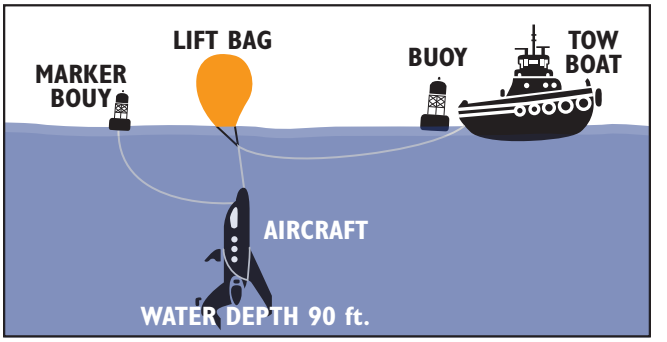
The Surface (Fuel) Slick

Perhaps one of the most valuable and least-understood indicators for locating a downed aircraft is the surface fuel slick. When an aircraft crashes into water, in nearly all cases fuel tanks are either ruptured or the fuel in the tank is slowly displaced with water. The sighting of a fuel slick is perhaps one of the easiest ways to determine the location of a submerged aircraft. Since the thickness of the slick may be only a few molecules, it can easily be understood that a very small amount of fuel may provide a large surface slick.

Surface fuel slicks, unless they originate from large quantities of fuel, are usually not highly visible from water level. In most cases, a fuel slick that can be easily seen from an aircraft will be invisible to anyone situated in a boat, even if they are located in the center of the slick itself. The appearance of a surface fuel slick is a result of reflective interference of the sun's rays as they reflect off the thin coating of fuel and off the water surface beneath it. This characteristic appearance, then, is dependent on direct light. It is because of this that fuel slicks are most easily sighted (a) from an aircraft; (b) between the hours of 10 a.m. and 2 p.m.; and (c) on a sunny day. Indeed, a fuel slick that may not be visible on the first day of the search if clouds are present may be obvious if the water is again searched (from above) when the sky is clear and the sun is shining directly on the water.



With the weight keeping the noose tight and the irregular shape of the wreckage preventing slippage, the aircraft may now be raised in stages using either a surface winch or an air lift bag. Once lifted a fraction of the distance, it may be towed to shallower water where the stage lifting process may be repeated. The buoy line should be kept free from the tow line (which has now become the lift line) to avoid entanglement.



While towing the wreckage, one person should be positioned at the towing point on the boat with an ax or other sharp device that can be used to cut the tow line. This is done if the tow boat is in danger of being sunk by the aircraft. The tow line is between the crash site and the shore. Should the wreckage sink the tow line, it can be cut, and the buoy will then mark the wreckage.

When a search for a submerged aircraft is conducted from the air, it would most appropriately be