Underwater Recovery Operations For Law Enforcement: An Introduction to Theory, Equipment, and Procedures Using Side Scan Sonar

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Introduction

This manual provides an introduction to underwater recovery operations using side scan sonar equipment. It is intended for use by law enforcement personnel responsible for conducting underwater search operations using side scan sonar. This manual will not make the user an expert in the use of sonar equipment, but, instead, will present the concepts and practical information necessary to conduct a well-planned and executed maritime search and recovery operation using side scan sonar in conjunction with an ROV (remotely operated vehicle) and divers. As with any complex operation, only practice and experience can produce a proficient side scan sonar operator. This manual will establish the foundation on which to build that experience.

Language commonly found in literature concerning side scan sonar emphasizes the ability of the operator as one of the key elements:

"...side scan sonar proved to be a useful tool for locating submerged cadavers. It was obvious that operator knowledge and competency with the equipment was extremely important when it came to interpreting the results accurately." Side Scan and ROV Based Sonar for Locating Submerged Cadavers, Bill Wiley, Niagara Regional Police Service, September 2001, p5.

"Experience plays a primary role in interpretation, which remains more art than science at present." REMR TN CO-SE-1.4 Suppl 3, Author unknown, p3.

This manual is not a detailed operator's manual. Because there are several manufacturers of side scan sonar equipment, this manual focuses on the fundamental concepts of conducting an operation using side scan sonar. Because EBRSO uses side scan sonar equipment manufactured by Marine Sonic Technology, Ltd., this manual makes regular references to that specific equipment. However, these concepts apply to any side scan sonar operation.

This manual was created by members of the East Baton Rouge Parish (Louisiana) Sheriff's Office Maritime Operations Team, with the support and encouragement of Sheriff Sid Gautreaux. The authors gathered the information presented in this manual through many hours of operational sonar deployments, studying operating manuals and industry literature, and training with experts. Gene and Sandy Ralston, Ralston and Associates, freely shared knowledge and experience with the authors. The Ralstons selflessly provide skilled sonar services and equipment around the country to help others in need. Further, the Ralstons offer seminars in the use of side scan sonar equipment and the interpretation of images. John C. De Mille of Marine Sonic Technology, Ltd., and Doug Stracener, JD, of the East Baton Rouge Parish Sheriff's Office, have each greatly

contributed to the author's abilities in using this equipment. Sheriff Gautreaux has made this document available to law enforcement personnel at no cost for the purpose of improving the quality of this service to the community.

Chapter 1: Side Scan Sonar and the Law Enforcement Mission

A single frequency side scan towfish can cost $20,000 while a splash proof computer can cost $4,000. When the cost of the sonar equipment is added to the cost of a boat with a boom-hoist and a two person scan team, this operation is very expensive to acquire and maintain. Considering the cost, why do law enforcement agencies invest thousands of dollars and spend numerous hours learning to operate side scan sonar equipment?

Side scan sonar equipment can enable an agency to:

1. Recover essential evidence of crimes.
2. Provide closure to victims' families by locating a lost loved one.
3. Recover valuable equipment lost underwater.
4. Identify potential hazardous situations in channels and harbors.
5. Conduct homeland security operations by conducting underwater security sweeps of ship hulls and critical infrastructure.
6. Assist in narcotics interdiction by conducting hull scans for narcotics "pods."

Obviously, an agency choosing to develop this capability can further its mission of public safety and public service.

Chapter 2: The Development of SONAR

Scientists began experimenting with sound underwater in the 1820's. Attempts to measure the speed of sound underwater began with crude equipments. Current technology has allowed scientists to determine the exact speed of sound.

Sound waves require a medium in which to travel. Since water is an excellent medium, sound moves nearly four times faster in water than in air. Consider the following speeds:

Light: 983,571,056 feet per second
Sound in air: 1200 feet per second, approximately
Sound in water: 4908 feet per sec, approximately
.45 caliber bullet: 850 feet per second, approximately

SONAR

Simply put, SONAR is using sound to "see" the objects or formations on the sea floor under a body of water.

SOund NAvigation & Ranging (SONAR) systems were developed during World War I for the use in anti-submarine warfare. Researchers determined that sound will hit an object underwater and reflect toward the source of the sound called a "transducer." Once scientists determined how to measure the exact difference in timing of the reflection, they were able to build an image of the submerged object. Of course, these images were initially crude smudges on a screen and many were indistinguishable from schools of fish or whales. While current technology is much improved, it is still important to understand the concepts of SONAR. Later in this manual, a function that is critical to image quality, Time Gain Compensation (TGC), is discussed. To understand TGC, the operator must have a conceptual understanding of SONAR.

Towfish

Side Scan Sonar systems require a sound generating device to emit and receive sound. This device is referred to as a "towfish." The system's towfish emits a high frequency mechanical sound pulse to one or both sides while being towed underwater. The sound travels through the water until it strikes a reflective object then returns to the towfish. The computer records the time it takes each pulse to return and constructs an image of the object. The density of the surface of the object reflecting the sound is critical to the image on the computer screen. A hard object will reflect more sound while a soft object will absorb more sound and return less. As such, harder objects will look brighter on the system screen than softer objects.

Below is a drawing representing a towfish being towed in the water.
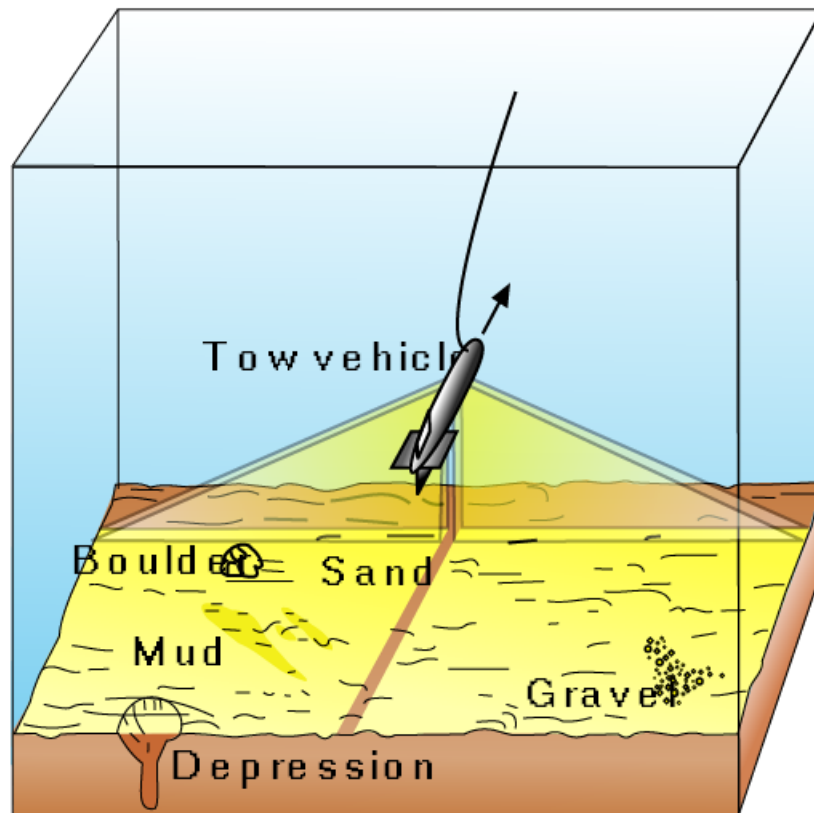
(Image obtained from http://en.wikipedia.org/wiki/Side_scan_sonar)

Towfish are available in various frequency ranges from 100 kHz to 1 MHz and in single or multiple frequencies. The higher the frequency, the greater the resolution of images on the computer screen. However, the distance a higher frequency sound wave can travel is relatively short. A high-resolution towfish (1200kHz) is useful when the object is small (a child or gun). However, for large bodies of water where the potential area is large, or the target is large (vehicle) a lower resolution towfish (600 kHz) is a more practical option because the covered range is larger. The optimal operational scanning ranges for various towfish are published for Marine Sonic Technology towfish on the Marine Sonic Technology website.

Only part of the sound reflects off objects to the towfish. Soft objects reflect less sound than hard objects. This concept is the basis for sonar and is apparent on the view screen. Hard objects are represented with brighter areas while softer objects are represented with darker areas.

Black areas are those in the "shadow" of an object and represent the absence of data. These shadows are areas where none of the sound pulse penetrated. Studying the shadow of an object is key in the identification of the object. Black areas can also be the bottom of depressions that escape the sound pulse. The "shadow" is actually caused by the side of the depression nearest the source of the sound. Since the far side of the depression is nearly perpendicular to the sound source, it may appear brighter than the nearest side.

Chapter 3: Side Scan Sonar Equipment

Computer

Although there are different brands of side scan sonar equipment, all of them work in the same manner. A transducer emits a sound pulse at or below the water line. Some transducers are mounted to the hull of the boat and others are towed by a cable. Generally speaking, operators can vary the altitude of transducers being towed by cables and, thus, are able to acquire the optimal angle for creating shadows. This concept, along with the recommended towfish altitude, is discussed in more detail later in this manual.

Regardless of the method used to move the transducer through the water, the pulse returns are gathered, digitized, and returned to the sonar's controlling computer via a cable. The computer program builds an image of the sea floor while recording important depth, location, and software settings. The researcher must constantly monitor the equipment settings to maintain the image quality while interpreting the images on the computer screen.

EBRSO uses the Marine Sonic Technology Sea Scan PC software with the Centurion Splash Proof computer. Below is a photograph of the Centurion system and towfish. Also available but not pictured is an external keyboard. This system can clip directly to a marine battery and is very convenient to load, store, and move around the boat. EBRSO brings a dedicated, fully charged marine battery to run the side scan sonar in order to insure there is no electrical interference from the boat's charging and ignition system.

Boat

In order to pull the towfish underwater, the scan team will require a boat with a boom-hoist type setup. Below is a photograph of the EBRSO side scan sonar equipment set up on a 23-foot Ocean Sprint boat.


Below is a photograph of the boat and towfish used by Gene and Sandy Ralston.

Towfish Connection

Below is a photo of a Marine Sonic Technology towfish. The towfish-computer interface cable connects to the plug on the rear of the fish. The Marine Sonic Technology interface cable is created specifically to tow the fish; however, some research teams tow with a separate cable. The tow point is the eye near the center of the fish. It is important the towfish is connected properly. Underwater obstructions such as brush and driftwood can cause damage to the equipment.

Tow Point

Interface Cable Connection point
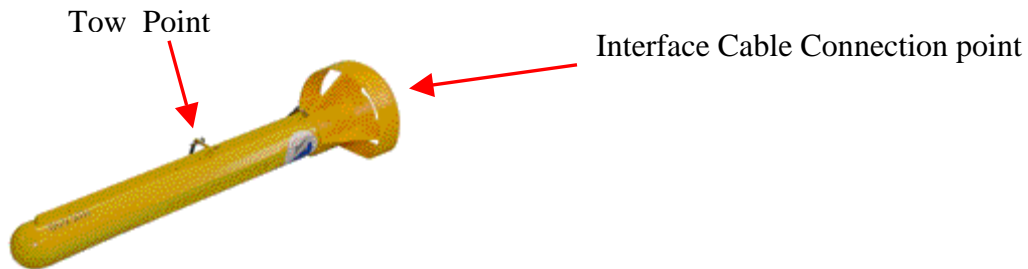
Another towfish is pictured below. As is apparent, towfish are designed in a similar manner. However, some towfish are intended for deepwater use and, thus are weighted and finned in different ways.
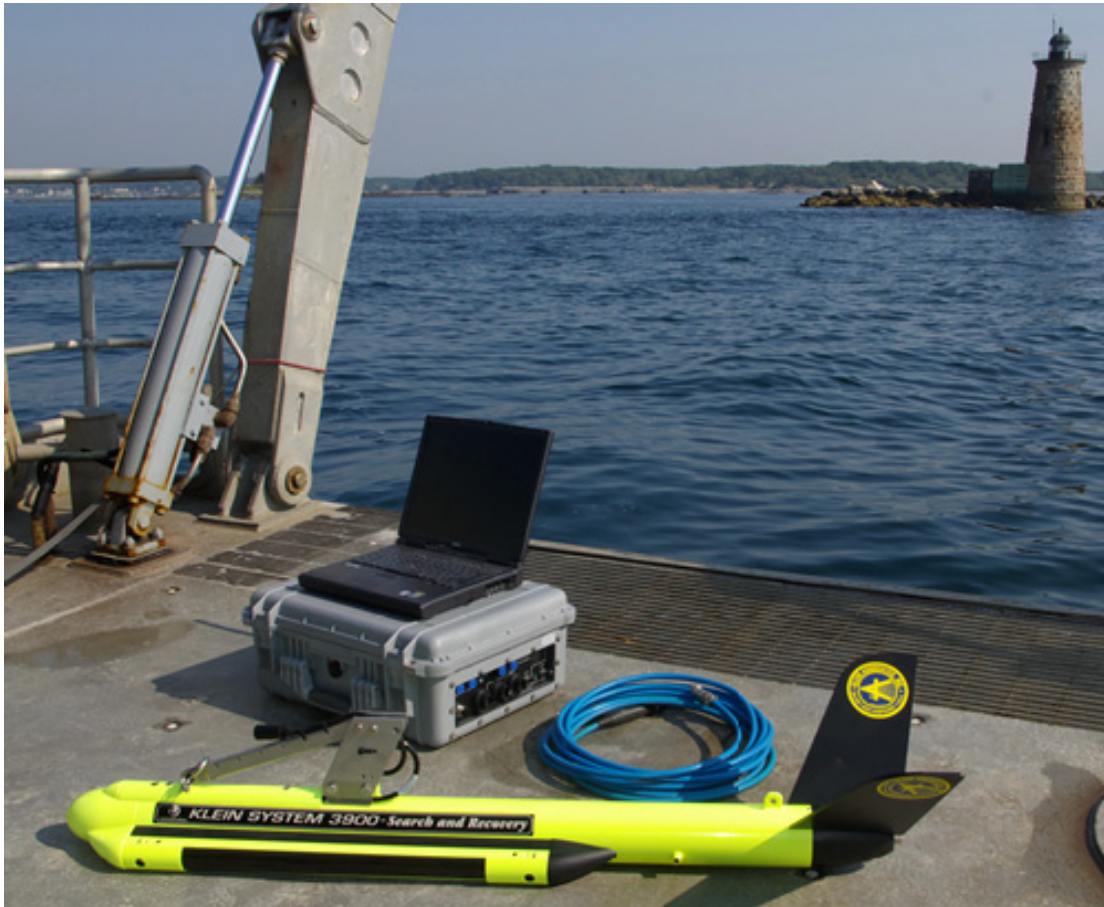
The Klein system and towfish are pictured below.

Photo credit – Garry Kozak.

Chapter 4: Conducting a sonar operation: Where do I start?

Conducting an operation with side scan sonar can be intimidating to the inexperienced and untrained. Not only is a criminal case or missing person search dependant on the research team's skill with this sophisticated equipment, but typically only minimal information is available to the search team. Considering this fact, it is of critical importance to approach every mission with a detailed plan. Mission planning begins long before a boat ever touches the water. In fact, it begins with the initial request from the client.

Side scan sonar operations in law enforcement are frequently done under less than ideal conditions. Law enforcement operations, unlike most professional hydrographic surveying operations, cannot always "wait out the weather." Environmental conditions or other circumstances may be less than ideal when the scan must be completed. Also, the area to be searched may be irregular, contain ground clutter, or present other conditions that make the following planning process impossible. The outline presented below is the ideal plan for scanning. Using common sense, experience, and the best effort to apply these procedures, the research team will be most likely to conduct a successful search.

One of the most important concepts in developing a search plan is time. Allow enough time to complete this mission. Side scan sonar operations are not assignments that should be completed in half a day. Typically, these operations will take place over several days. Suggested steps to the mission planning process are presented below.

Search Strategy

1. **Have a plan.** These operations are too big and too important to go into haphazardly or in a random nature. Before beginning, obtain the following information:
   a. What are you looking for?
   b. How long ago did the object go underwater?
   c. Where, approximately, did the object go underwater?
   d. Is this an operation to be completed in an urgent manner?
   e. Is this a criminal investigation? If so, remember that your team could be working within a crime scene. Make contact with the responsible jurisdiction prior to conducting any activities and gain permission, gather necessary information on the incident, and review the procedures for evidence.
   f. Have a mechanism to transfer your operational report and images. Not all agencies have USB drives, DVD recorders, and other high technology items - you may need to make hard prints of images and copies on VHS videotapes.
   g. What are the characteristics of the body of water? Salt, fresh, depth, sea floor makeup (rock, sand, mud, other), water temperature, wind, current, tides, air temperature. You may need to modify some equipment prior to getting underway.
   h. Obtain navigational charts for the body of water to be scanned. Navigational charts are a good source of depth and layout information. If navigational charts are not available, obtain satellite images, terrain maps, or, at a minimum, hand-drawn diagrams.
   i. Does the client expect to see other similar items on the sea floor?
   j. Have other sonar operators searched the area? If so, are those images available for your review?
   k. Have other techniques been used such as dog searchers or draglines? If so, were there any hits or potential snags to investigate?

2. **Develop a search pattern.**

    a. Section off the entire area in blocks that can be scanned with the towfish in less than two hours. Mark each section as "most likely" to "least likely" according to the information obtained during the initial planning phase.

    b. Program your search grid into a navigational software package that will track your search. EBRSO uses HYPACK MAX surveying software to create a search grid. For information on using HYPACK software, contact the EBRSO Maritime Operations Team. Other software is capable of accomplishing this task, such as FUGAWI.

    c. Completely scan the most likely section first with the side scan sonar. Scan one complete section at a time. Be sure to save all sonar images using auto save. This function will be discussed in Chapter 5.

    d. Mark all potential objects or unidentifiable objects with the sonar computer program's plotter function and assign those objects a unique name. This procedure is also outlined in Chapter 5.

    e. When the first section has been scanned, return to the most likely object and mark it with a sonar marker. Inspect each object in a sequential manner using the remote underwater vehicle, or if necessary, a diver. Eliminate each potential target in the section in this manner.

    f. When complete with the first section, move the next most likely section.

3. **Creating the search areas.**

    a. Mark squares on the navigational charts, satellite images, or maps with the most likely to least likely areas indicated. Conduct a non-scanning tour of each area by boat and record depth information and GPS coordinates for the center point of each side of the search squares. Record the estimated distance, in feet, of the length and width of the search areas.

    b. Create the search squares small enough to completely scan in 1 - 2 hours.

    c. Mark the center of each Search Area boundary line with GPS coordinates labeled: 1a, 1b, 1c, 1d; 2a, 2b, 2c, 2d; etc.
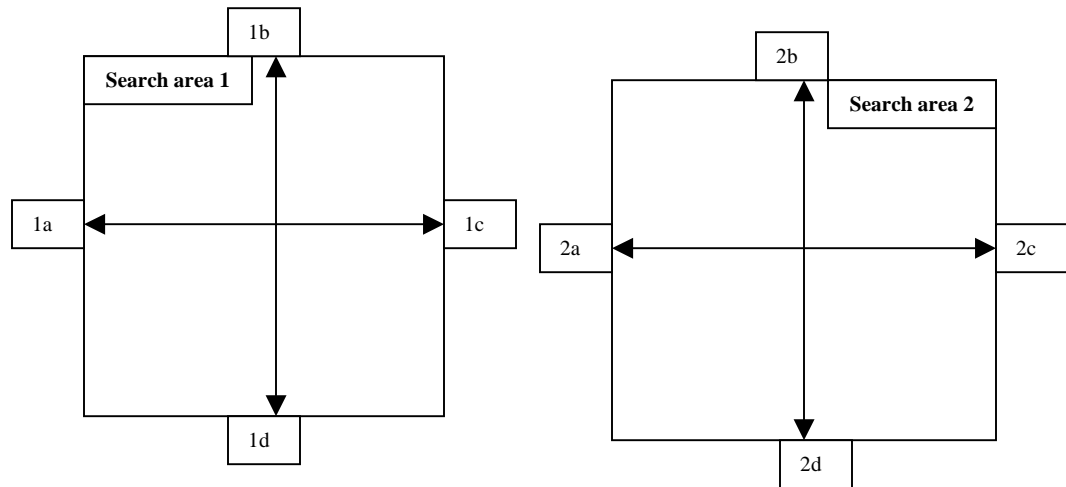
     d. Use a search grid plotting program (HYPACK) to establish the search
        areas using the parallel lines pattern.

Depending on the target characteristics, each search swath could be from 66 feet to 164 feet in width. For smaller objects such as weapons and children, deploy the highest frequency fish possible set to single channel (one side only) scanning with a 66-foot search pattern. For adults or vehicles, or searching areas with smooth, firm bottoms (sand) and no bottom debris, it is acceptable to start with a broader, single channel search swath such as 164-feet. Using the single channel scan allows the entire computer screen's width to display one side of the towfish returns. This practice will result in larger images of objects. Scanning both channels at the same time "shrinks" the resulting image into the size of the screen.

The parallel lines of the search pattern should be set to allow scanning overlap of the previous run. Set the parallel line distance to allow generous overlap in the scan ranges. The overlap will 1) insure all areas are covered; 2) allow for viewing objects at different towfish angles; and 3) allow for variations in the tracking of the boat as it moves along the search line.

Sonar researchers recommend establishing a search pattern that will allow 200% coverage of the sea floor. The most effective grid line setup is for the line separation distance to be set at one half of the search swath. By scanning each section multiple times from different angles, the operator is given different "shadows" for the same objects. For example, if the single channel sonar range is set to 66 feet, set the search grid lines at 33 feet apart.

For dual channel scans, Kozak recommends the parallel line distance to be set at 65% to 75% of the dual channel swath. This distance ensures the invisible area directly beneath the towfish is scanned on subsequent passes. For more information on search patterns, refer to the list of references at the end of this manual.

Finally, expect to scan each area twice at right angles. If the scan was conducted North-South the first time, the second scan should be East-West. Varying the scan angle will provide a different perspective for acoustic shadows.

Setting the search grid is possibly the most complex part of the operation. It is very important all areas are thoroughly scanned. Using software packages such as HYPACK or FUGAWI to assist in this process is important to conducting a detailed search. Unfortunately, these software packages tend to be complex for the occasional or untrained user. EBRSO recommends investing in the time and training. In addition, EBRSO will assist in training any team in using HYPACK.

Chapter 5: Conducting The Operation

This section presents information general to conducting sonar operations and specific to the Marine Sonic Technology, Inc. Sea Scan PC software and equipment. Since each software package may be different, the applicability of this information will vary from user to user. Do not use this section to the replace the equipment Operator's Manual. In addition, Marine Sonic Technologies offers technical assistance 24 hours a day, seven days a week.

Load the side scan sonar, Sonar Marker, Underwater Camera (ROV), anchor, charts, maps, food and water in the scan boat. A portable toilet would be useful if your boat is not equipped with a head to maintain continuity of the mission.

Connecting Equipment and Towfish

Carefully follow the manufacturer's instructions when connecting all the equipment. There are very specific procedures including inspecting shear bolts, drying connections, and "Powering On" and "Powering Off" sequences that must be followed.

Working With the Scanning Software

1. **Starting the Program**
   a. Open the Sea Scan PC program.
   b. Select the POWER button in the top left.
2. **A Tour of the Operating Screen – Sea Scan PC**
   a. The viewing screen is the open square in the lower right section of the screen. The status and controls are across the top and left side of the screen.
   b. The typical law enforcement research team will not use many of the controls and features in the software. This manual only presents the most commonly used features.
3. **Testing the Marine Sonic Technology Towfish**
   Prior to deploying the fish, the device and connections should be tested. This is a simple procedure that only takes a few minutes.

   a. Turn the POWER button ON to start the pinging process.
   b. Set the Range to 10 meters, no Range Delay.
   c. Set the Speed Over Ground (SOG) to the maximum allowed.
   d. Set the Time Gain Compensation (TGC) to maximum.
   e. Set the Channel to read left and right simultaneously.
   f. Physically rub the left side of the towfish with your hand.
   g. Physically rub the right side of the towfish with your hand.
   h. You should see returns on both sides of the computer screen.
   i. If you see returns, both channels are functioning.
   j. If not, inspect the connections and re-test the device.
   k. Close the program – DO NOT SAVE SETTINGS.
   l. Re-open and begin scanning.

4. **Channel** – this setting tells the towfish to look left, right, or in both directions simultaneously. Most scans will be one channel scanning only. It is possible to effectively use dual channel scans if the target is large (vehicle or boat).
5. **Range** – this figure indicates the width of the search swath, how "far" the computer is looking from the towfish.
6. **Range Delay** – it is possible to look at a specified range, say 50 feet, starting at 25 feet from the towfish. In this example, the computer would begin looking 25 feet from the towfish and out 50 feet from that point. In effect, your search swath would extend to 75 feet from the towfish but would skip over the first 25 feet. This is an advanced feature and is not recommended. If the Range figure is followed by "-RD" then the Range Delay is activated. Double click the Range figure to disable Range Delay.
7. **Offset** – Since the towfish is probably not lying directly under the Sea Scan PC GPS input device, the GPS coordinates on the monitor will not precisely coincide with the location of the towfish, and, as such, the object being scanned. If you are confident in the separation between GPS device and towfish, set the offset distance. However, with shallow water operations (less than 100 feet in depth), it is unnecessary to set this distance as it does not have a significant impact on location.
8. **Layback** – this concept is the same as Offset. For shallow water operations, this is not a significant problem. Refer to the above discussion on Offset.
9. **Saving data**

    Sea Scan PC will save "images" while you scan. These images are actually small files that contain information about the current settings, location, and other information about the program at the time the image was saved. The operator can later open these files in a separate program called Sea Scan Review to study the scans in detail.

    The program can default auto-save or can be set to save manually, upon command, to a pre-determined drive and folder. To use the auto save feature, simply activate auto-save. The files are saved in C:\SSPCDATA by date and sequence number.

    To manually save files, follow the following instructions:

    a. Options – Settings – Express Save – Select Directory
    b. Select the directory.
    c. To save the last 1000 lines of data, press the floppy disk icon on the left of the screen.
    d. The operator can also select a unique name for each file.

    To facilitate later review of the saved image files, open the "Data Storage" window and move it to the lower right corner of the screen. When an image of interest is observed, electronically mark the object and save the file. The operator can write the data file name and marker in a journal. The Data Storage window is accessed by Options>Status Boxes>Data Storage.

10. **Gain** – the Sea Scan PC Operator's Manual provides a detailed discussion of Time Gain Compensation. This section is a brief summary. For detailed information, refer to the manual. In summary, Gain adds signal strength to the acoustic returns to make up for lost signal from distance and interference. When you increase the gain, you are artificially adding signal strength to the acoustic returns.
    a. Optimal Image Quality – Manual control of gain is the best practice. The goal is to create an even, light brown image that is consistent across the screen. Adjust the gain to remove bright blotches and dark spots.
    b. Manual Adjustment – Open the Gain window and, using the mouse, click and drag the adjustment bars up and down until the optimal image appears.
    c. Auto Gain – With this setting, the computer automatically adjusts the gain in attempt to optimize the returns. Once auto gain is complete, in about 60 seconds, revert to manual gain to create the best image on the screen.
11. **Plotter** – this feature automatically creates a bread crumb trail of the search pattern including the search swath. When objects are marked in Sea Scan PC, they will appear as blocks in the Plotter function.

MARKING OBJECTS

Sea Scan Plotter

The Plotter function in Sea Scan PC tracks the progression of the boat as the scan is conducted. As the sonar operator sights an object of interest, it is a simple process to place an electronic marker on the item within the Plotter feature. Refer to the Operator's Manual for the specific equipment for more information. After marking an object, record the waypoint number and the name of the last save image file for later study. Gene and Sandy Ralston developed a worksheet to keep track of this information.

After scanning the entire search area, the operator can return to each electronically marked object sequentially and begin checking each target with an underwater camera.

Sonar Marker

Some sonar teams use a device called a Sonar Marker to drop in the water near an object in order to clearly mark its location. The sonar marker is square. Since perfectly square objects rarely appear in nature, the sonar marker is clearly identifiable on the sonar image. Further, the weighted square is tethered to a floating buoy that is under constant slip tension, and, as such, stays afloat directly over the sonar marker. Using a sonar marker placed near an unknown object, an ROV operator or diver can easily locate the object for positive identification.

The EBRSO sonar marker consists of two plastic crates lashed together (one on top) with weights in the lower crate. A six-foot chain, similar to an anchor chain, is attached to the marker tether line to keep constant tension during surface wave action. The EBRSO

marker has four aluminum plates 4" x 11" bent in an approximately 40-degree "V" to provide a stronger acoustic return. The EBRSO marker has enough line for 77 feet of water. The marker tether line will need to be extended for deeper operations.

Attached to the top end of the tether line is a 10-pound dive weight with the line looped once through the marker buoy. The dive weight pulls down on the line to keep the floating buoy directly over the sonar marker on the sea floor.

In addition, a fender is tethered to the surface float to indicate wind direction for anchoring purposes. For dive or ROV operations, it is important to anchor the boat directly down-wind or down-current of the marker to prevent the boat from drifting over the target.

When the sonar operator identifies an object to be inspected with an ROV or diver, the scan team drops the marker approximately 10 feet from the object. Do not drop the marker directly on top of the object. The ROV operator or divers will use the marker to find the object.

The EBRSO Sonar Marker
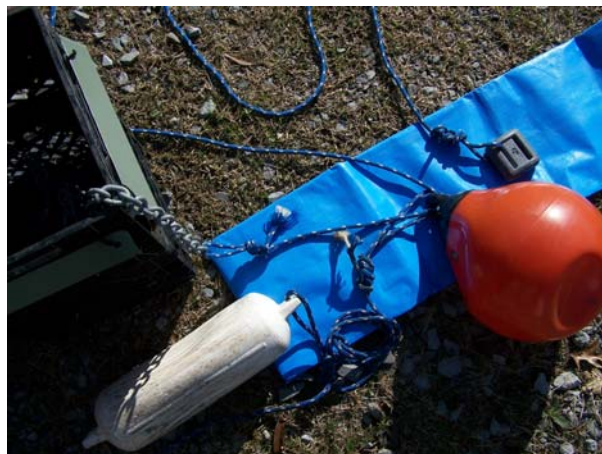
Basics in Technique

1. **Optimal Altitude** – the recommended altitude for the towfish is 10% to 20% of the range being scanned. This angle creates the most identifiable shadows from objects of interest in the water such as human bodies. For example, if the scan range is set to 20 meters, the towfish should be pulled at approximately two to four meters above the bottom.

2. **Optimal Speed** - the scanning operation should be conducted at 2 – 3 knots. Since the towfish is pinging, moving too fast will possibly skip objects and moving too slow will not only waste time, but may cause some overlap in the pinged area. The Sea Scan PC speed indicator at the top of the screen will turn red when the program detects the fish is moving too fast.

3. **Boat Depth Finder Interference** – if small bright spots appear on the screen, this is possibly caused by the boat's depth sounder. A typical recreational grade depth sounder is a sonar device, usually operating in the 50 to 200 kHz range, and is constantly emitting sonar pulses. If the spots interfere with your image quality, simply turn off the boat's depth sounder.

4. **Effects of Choppy Water** – the optimal placement in tethering the towfish to the boat is mid-ship. Because the boat will pitch with wave action, a towfish connected to the bow or stern will tend to be pulled up and down with the boat. In smooth water, this problem does not exist. If the operation is taking place in rapid river water or coastal areas, attempt to scan in a manner to minimize the boat pitching movement. This effect will be apparent in a wavy image on the screen.

5. **Repeatability -** An actual object on the bottom will be detected by sonar each time it is scanned. As such, if a possible target is detected, scan the area again. If it is a random anomaly such as floating debris or fish, the sonar will present no returns. Kozak recommends applying the practice of "repeatability" – the viewing and comparing of the same area of the seafloor data collected at different times. EBRSO adds that varying the angle of scan, either altitude or laterally, can increase the likelihood of positive identification of a target.

What To Look For

1. *Bright areas on the screen.* Hard objects will reflect most of the acoustic impulse and create a bright spot on the screen. Soft objects, like human skin or outer clothing, tend to absorb sound and will not make a bright return.
2. *Dark areas on the screen.* When the acoustic impulse is absorbed or blocked by an object, there will be no signal return to the towfish.
3. *Shadow shapes.* Using shadows is likely the most effective means of detecting a human body. Consider that a body is soft, made mostly of water, and is possibly clothed. As such, it is unlikely that a body will cause as bright of an image on the screen as, say, a rock or automobile. A human body will, however, absorb most of the acoustic impulse. By looking for shadow caused by the body, the researcher will increase the probability of detection.

Shadow Interpretation - There are publications and training images on numerous websites of human bodies and other objects. Image interpretation is beyond the scope of this manual on basic sonar operations. We strongly recommend further study, including visiting the Marine Sonic Technology Internet web site for more information on this process. In addition, Gene Ralston offers a seminar on image interpretation. Contact the Ralstons for more information.

Because the sonar impulse also travels to the surface, objects on the surface will appear as images on the computer screen. Surface returns, or near surface, returns from white caps, boats, floating debris, schools of fish, and prop wash can cover the bottom returns. Consider these conditions during scanning.

It is possible to measure towfish altitude, water depth, and the size of objects. Sea Scan PC has a measuring feature that allows the researcher to determine the height, length, or area of an object. Refer to the Operator's Manual for details.

Side Scan Sonar in Coordination with ROV Cameras

Once an object to be inspected has been identified by sonar and marked with a marker, it will be necessary to anchor the scan team boat to deploy the ROV. Move to the upwind or up-current side of the sonar marker buoy and anchor approximately 10 - 15 feet from the buoy before deploying the ROV. This distance will allow the ROV operator enough room to move to the marker connection line and attach to the line with the ROV.

Deploying the ROV

While it is still on the surface, move the ROV to the marker bouy. Open the forward pinchers on the ROV and insert the marker's connection line inside the pinchers. Follow the marker connection line to the sea floor. This technique will place the ROV close to the object to be inspected.

The Video Ray ROV system has a short range forward looking sonar. While the sonar is not as detailed as the images on the side scan sonar, the ROV sonar will identify an object in close proximity. Maneuver the ROV using the sonar until the object comes into view

with the ROV camera. Attempt to "stir-up" as little sediment as possible by minimizing the ROV contact with the sea floor. The sediment will interfere with the camera view.

Object Identification

Gently nudge the object to determine its physical properties. Sometimes a body can look like a stone or tree because of the decomposition process. It may be necessary to hit the object with the ROV to determine if it is flesh or stone. Use the front pinchers to obtain a sample, if necessary. If possible, use the ROV to recover the object. This will prevent having to deploy a diver.

Side Scan Sonar in Coordination with Divers

After inspecting an object with the ROV, the operation commander may decide to send divers. The object may have been identified as the subject of the search or the object may need first hand inspection to make a determination.

When divers are being deployed, the sonar team will leave the marker in place but the sonar team will leave the area with all sonar and ROV equipment. There is a chance that a diver could become entangled or injured from the sonar or ROV cabling. It is not recommended to deploy either the sonar fish or ROV while divers are in the water due to the risk of line entanglement or injury from the ROV propellers.

If the ROV becomes entangled and divers are being used to recover the device, shut off all power to the ROV prior to the divers entering the water. Allow the divers to free the ROV and return to the surface prior to restarting the device.

Release of Information

Since most of these operations are conducted incidental to some criminal investigation, all information concerning the sonar operation should be funneled through the primary investigating agency. The EBRSO Maritime Operations Team does not release any information concerning the specific operation to any member of the media, victim's family, observers, or other law enforcement agencies. Following this practice will ensure the primary agency controls the investigation. With permission from the primary investigative agency, the EBRSO Maritime Operations Team will provide general informational interviews with the media concerning side scan sonar operations. However, no specific information concerning the operation is discussed.

Since Sea Scan PC can save the sonar images, and the operations are usually conducted as a result of a criminal operation, the EBRSO Maritime Operations Team considers the images the same as crime scene photographs. Images that are of interest to the investigator, including bodies or other evidence, are saved to portable media and turned over to the investigating agency. In addition, EBRSO will save duplicates of the images on portable media and submit them to our own Evidence Division as a Public Assistance case. Using this method, if the EBRSO research team is ever called to testify in court, the necessary information will be available.

Chapter 6: Documenting The Operation

After Action Report

As with any law enforcement activity, documenting actions is very important. Side scan sonar operations are no exception to this rule. The EBRSO Maritime Operations Team completes a detailed After Action Report (AAR) following each operation. This document not only records our activities but also serves as a reference for future operations or court proceedings. In addition to a detailed description of team activities, the AAR includes a section for lessons learned. At a minimum, the AAR should include the information presented below.

<u>Sample format of sonar operation After Action Report (AAR):</u>

Operation: Maritime Recovery Operation   **Date:** <dates of operation>

Location: <specific location: city, state, GPS coordinates, etc.>

Requesting Division / Agency: <organization>   **File Number:** <case #>

Authorization by: <authorizing person>   **Operation Commander**: <name>

Description of Team Actions: On the above date, Sgt. Todd Martin and Lt. Darryl Armentor … <include complete detailed narrative of general circumstances causing the search - homicide, missing person, drowning, etc., along with the description of search team activities and results>.

Information learned:

1. List tips, suggestions, or other lessons learned during this operation.
2. …

Injuries: <detail any injuries>

Property Damage: <list any damaged equipment>

Requesting Agency/Organization Point of Contact: <name, contact information>

Requesting Agency Case Number: <case number>

Report Prepared by: <name>

Photographs/video: <list if any photographs/video is available and the location>

CHAPTER 7: Summary

Conducting sonar search and recovery operations is a challenging and rewarding function of law enforcement. Since these operations are usually of critical importance to an investigation, it is important that the sonar research team take every effort to conduct the most effective search possible. Only practice and experience can create a great sonar operator. This manual is intended to be a tool for the beginning sonar search team. Additionally, experienced teams may find it useful to refresh concepts and methods prior to an operation. The most important factor to remember is that each sonar operation must be carefully planned and executed if it is to be successful.

Legal Disclaimer

The information and resources presented in this document are for informational purposes only, and EBRSO does not guarantee the accuracy, completeness, usefulness, or adequacy of any information or resources included herewith. In no event shall EBRSO, its agents, employees or assigns, be liable for any damages of any kind or character, including without limitation any compensatory, incidental, direct, indirect, special, punitive or consequential damages, loss of or damage to property, claims of third parties, or other losses of any kind or character, arising out of in connection with the use of this document.

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gralston@mindspring.com

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