

Session II- Part B

In the previous chapter we considered how to address some of the most important factors associated with planning a field sonar survey. It's time to discuss the actual data collected during the mission, and make sure the gear is set up properly and ready for action.

The Sonar Mission



The Snapshot Approach

The method we have developed for capture and processing of raw sonar imagery- the method we are teaching in this workbook- is called the "snapshot approach".

The snapshot approach requires the acquisition of three critical data sets during a sonar survey. The first data set is a collection of consecutive, **raw sonar images** that have a small portion of overlap. (This overlapping portion will later be automatically removed during image processing and the creation of mosaics). The raw sonar image data set must be manually acquired by repeatedly pressing a button on the control head. The second critical data set is automatically generated during image capture- a set of coordinates that can be used to reference each image capture location. We refer to this data set as the **Waypoints**. The third critical data set is a set of coordinates that reference the survey track, or the actual path taken by the boat during the survey. We refer to this data set as the **Trackpoints**.

Let's discuss how to set up the sonar gear to successfully acquire these three critical data sets.

Snapshot Approach requires 3 Critical Data Sets acquired during mission

- 1. Raw sonar images- must be consecutive, overlapping**
- 2. Coordinates for image locations (Waypoints)**
- 3. Coordinates for survey track (Trackpoints)**

The Control Head

The sonar control head should be placed near to, or directly in front of the boat operator as shown in this photo. Sonar surveys can easily be conducted by a one person. This one person will simultaneously drive the boat and manipulate the sonar gear. Hundreds of miles of streams have been surveyed in this manner.

While a survey is underway, the boat operator will typically need the feedback provided by the on-screen imagery to maintain proper boat position. For example, the apparent position of the stream banks in the imagery helps the boat operator maintain position in the middle of the river channel, or maintain a fixed distance from the lakeshore. The control head should, thus, be close enough and at the proper level for the boat operator to see the screen and reach the buttons. With a little creativity just about any boat can be properly outfitted with the control head. In this example, we built a platform out of scrap wood in the garage that we bolted to the side and floor of the boat. This frame carried our original 981c SI control head for surveys over a 5-year period. Not fancy but functional.

*Although a holster for the GPS was attached to this platform, the GPS was actually placed adjacent to the transducer during surveys- not on this console.

Boat Configuration Control Head Placement



Within easy reach

With the control head front and center, the boat/sonar operator has real-time feedback on boat position. One hand is available to operate the tiller or wheel, and the other is available to press the Mark button during image capture. If the boat begins to drift toward one bank or the other, the effects will be immediately visible on screen, and smooth, gradual adjustments can be made to correct position. The whole process unfolds at a slow rate of speed, a topic we will soon discuss. Watching the sonar screen is like looking in a rear view mirror. If you can check the mirrors while driving a car, you can drive a boat and operate the sonar gear.

*Note the extra gas tank on board. No sense in running out of gas miles away from the boat ramp.

Boat Configuration Control Head Placement



A few options exist

Let's discuss the very important decision of where to locate the transducer. A few options exist, the first is described in the Humminbird SI manual. **Option A** is to mount the transducer directly to the transom of the boat as shown here. The foot of the transducer must hang slightly below the bottom of the boat. The transducer must be placed either to the right, or to the left of the outboard motor.

The benefits of transom mounting the transducer include the ease of cleaning debris from the transducer that may accumulate during a survey, and perhaps some measure of protection from head-on collision hazards.

The costs associated with transom mounting include the fact that the transducer is fixed in position, and adjustments are limited. More significant, however, is the loss of image resolution that is incurred as a result of prop-wash turbulence created by the neighboring outboard motor.

Boat Configuration Transducer Placement

Option A)

Transom mount

Benefits-

- **protection**
- **easy to clean debris**

Costs-

- **Adjustments are limited. Transducer fixed, depth below water surface fixed**
- **Prop-wash degrades resolution**



The custom mount

A second option for placement is to put the transducer out in front of the boat using a custom mount like the one shown here. This mount consists of a \$50 MotorGuide trolling motor bracket, a section of galvanized pipe, and a customized adapter for transducer attachment. This elegant mount was developed after testing several prototypes.

The benefits of using a custom mount to position the transducer in front of the survey vessel are substantial. The forward position puts the transducer in a environment of very low turbulence. The transducer is now the first object to pass through the water column; all of the turbulence created by the boat and the motor are rendered inconsequential. The trolling motor clamp allows this mount to be placed in several different locations on the boat, and a tightening screw enables the adjustment of the depth of the transducer by simply lowering or raising the pipe. A push button on the mount allows the transducer to be raised out of the water while running upriver, and a series of notches on the bracket allows the rod and transducer to be positioned at a perfect 90 degree angle to the stream bottom. When the survey is complete, the mount can be removed from the boat.

The costs of forward deployment include added difficulty in cleaning debris off the transducer (although a single operator can do so), and the possibility of head-on collision involving the transducer. We have never damaged a transducer in this manner.

Boat Configuration Transducer Placement

Option B)

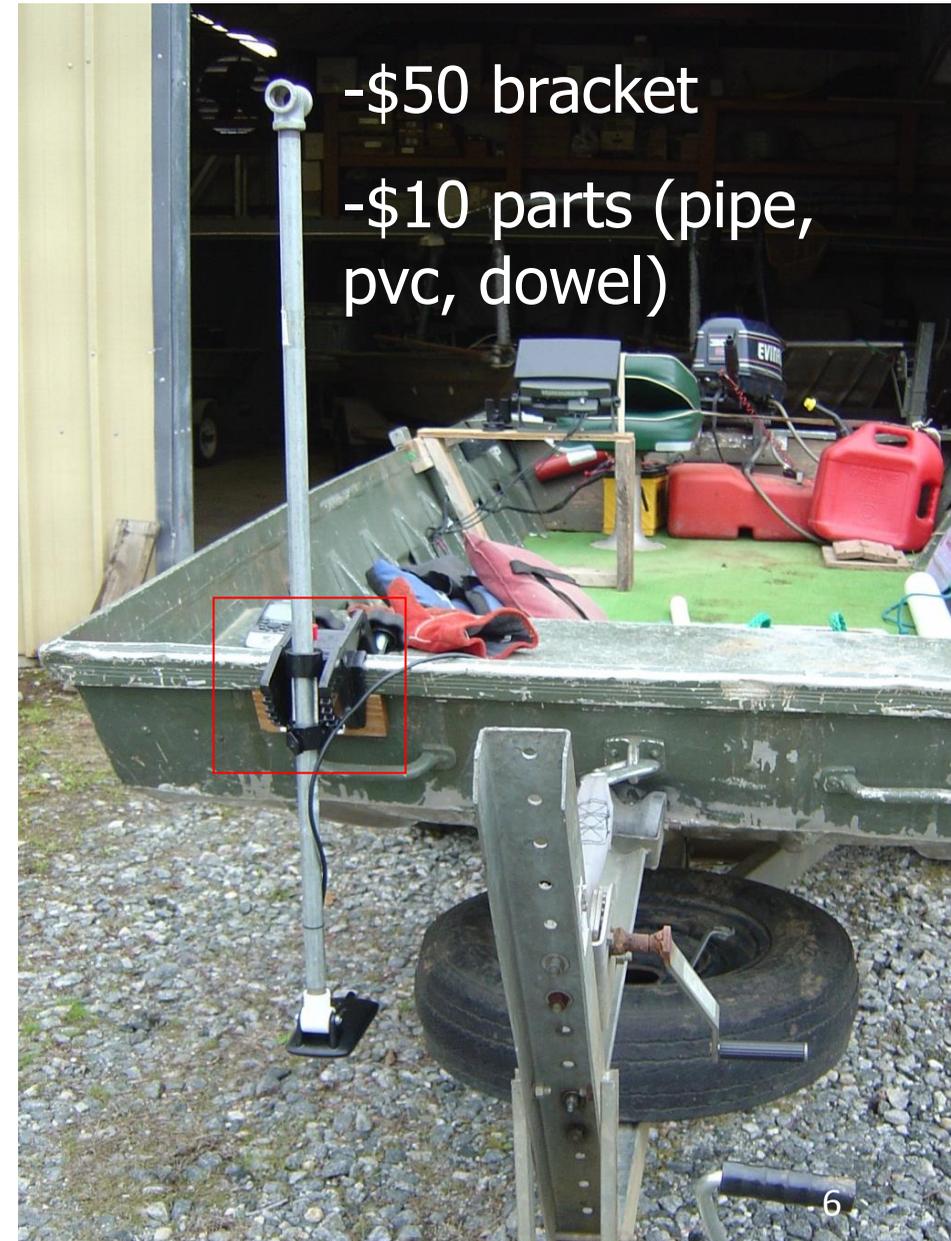
Trolling motor mount

Benefits-

- **greatly reduces turbulence**
- **multiple positions, adjustable**
- **can be raised while running river**

Costs-

- **harder to clean debris**
- **head-on collision hazard**



Attaching the transducer

To attach the transducer to the end of the pipe, we took an appropriately sized PVC T-connector, cut the wing ends off with a hack saw, and used a rubber mallet to pound a small section of wooden dowel, that had been sanded to size, into the connector. We then used a drill press to drill a perfect hole through the dowel to accommodate the hardware used to attach the transducer.

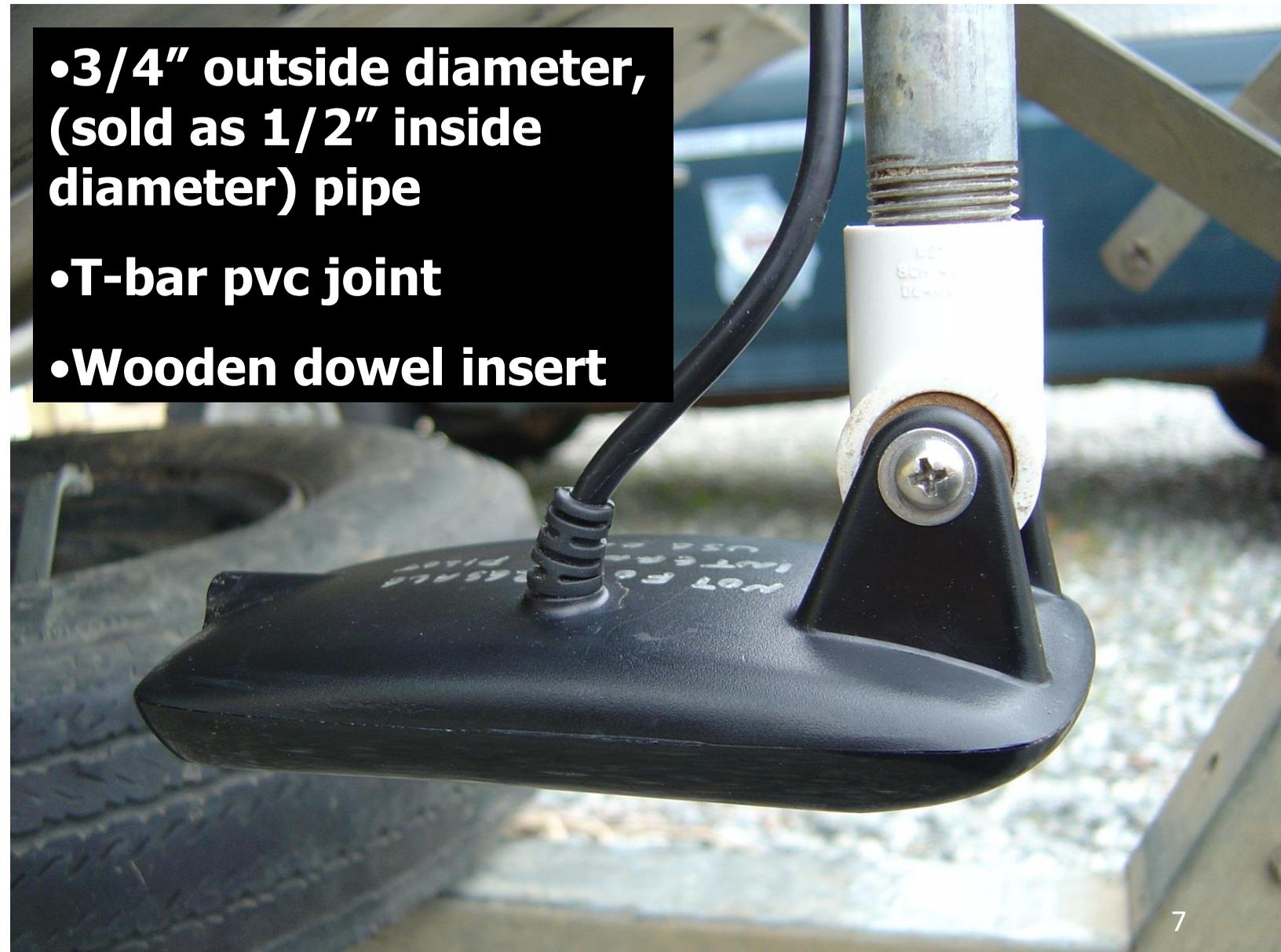
This small adapter (shown right) works superbly, except that between surveys the wooden dowel may dry out and shrink within the PVC piece, causing the transducer to pivot freely. To circumvent this problem, we remove the transducer and the PVC adapter after each survey, and place the adapter in a small, sealed jar of water. This little jar is stored in our equipment kit. The dowel never dries out, and remains fixed inside the PVC piece ready for the next survey.

Another option that works perfectly is to use a galvanized fitting like the one shown below, drilled out to accommodate the attachment hardware.



Boat Configuration Transducer Adapter

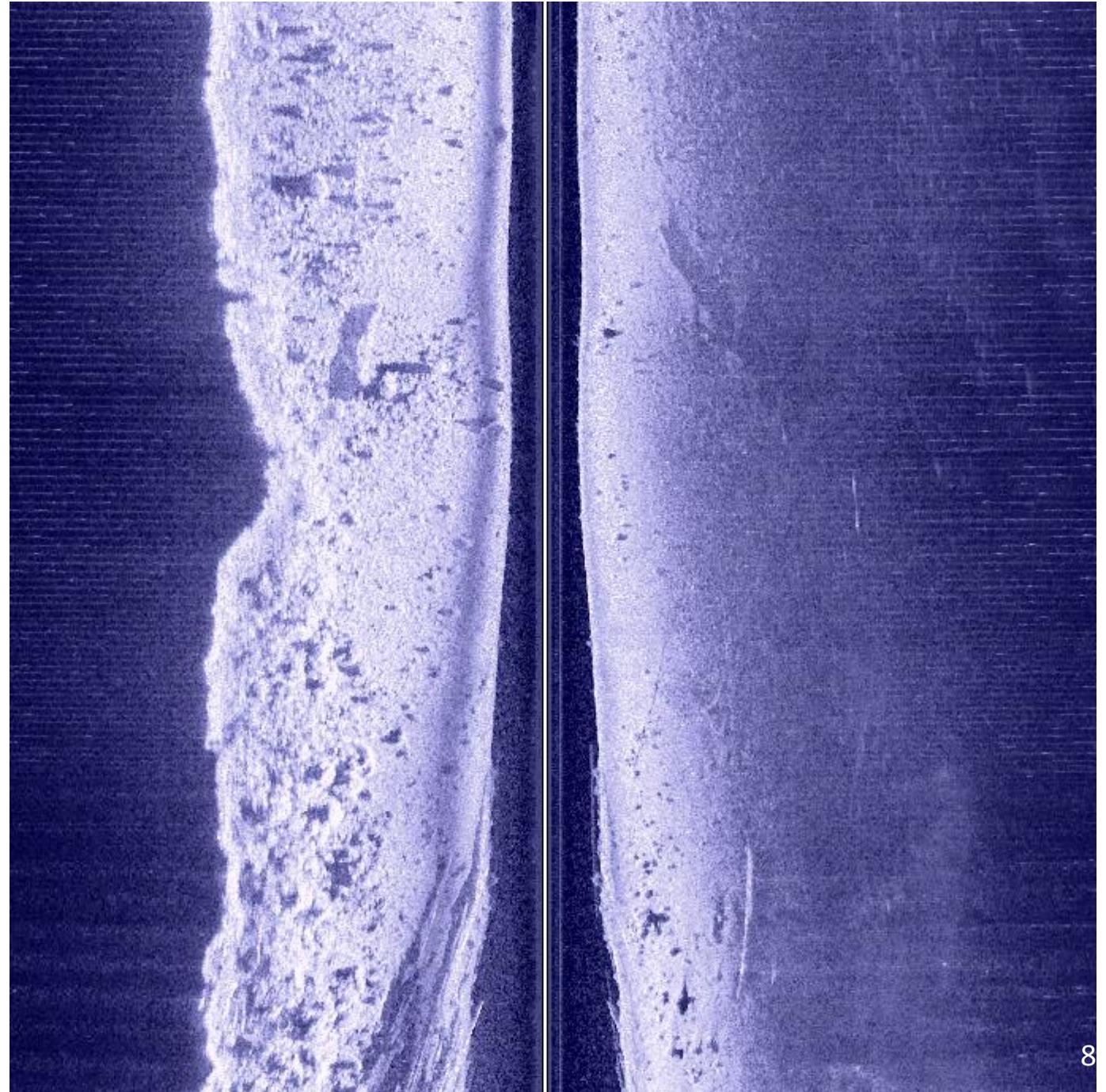
- **3/4" outside diameter, (sold as 1/2" inside diameter) pipe**
- **T-bar pvc joint**
- **Wooden dowel insert**



Rear mount transducer

We often joke with our audience that the advice given on forward-mounting the transducer with a custom mount is worth the price of admission. Why is forward mounting so important? For a year or so we rear-mounted the transducer and captured imagery like the example provided here. In our naivete, we thought our images were great, and marveled over their beauty...that is, until we started really studying them! Look at how well defined the left bank is compared to the right bank. The right bank, and all of the features to the far right of the image, are hardly visible at all! By repositioning the transducer to the opposite side of the transom, we found the effect would then appear on the other side of the image. Clearly, what we were seeing was the result of turbulence created by the motor's prop wash. The signals being sent in the direction of the motor were being degraded. Let's look at imagery from this very same reach of stream captured using a forward-placed custom mount.

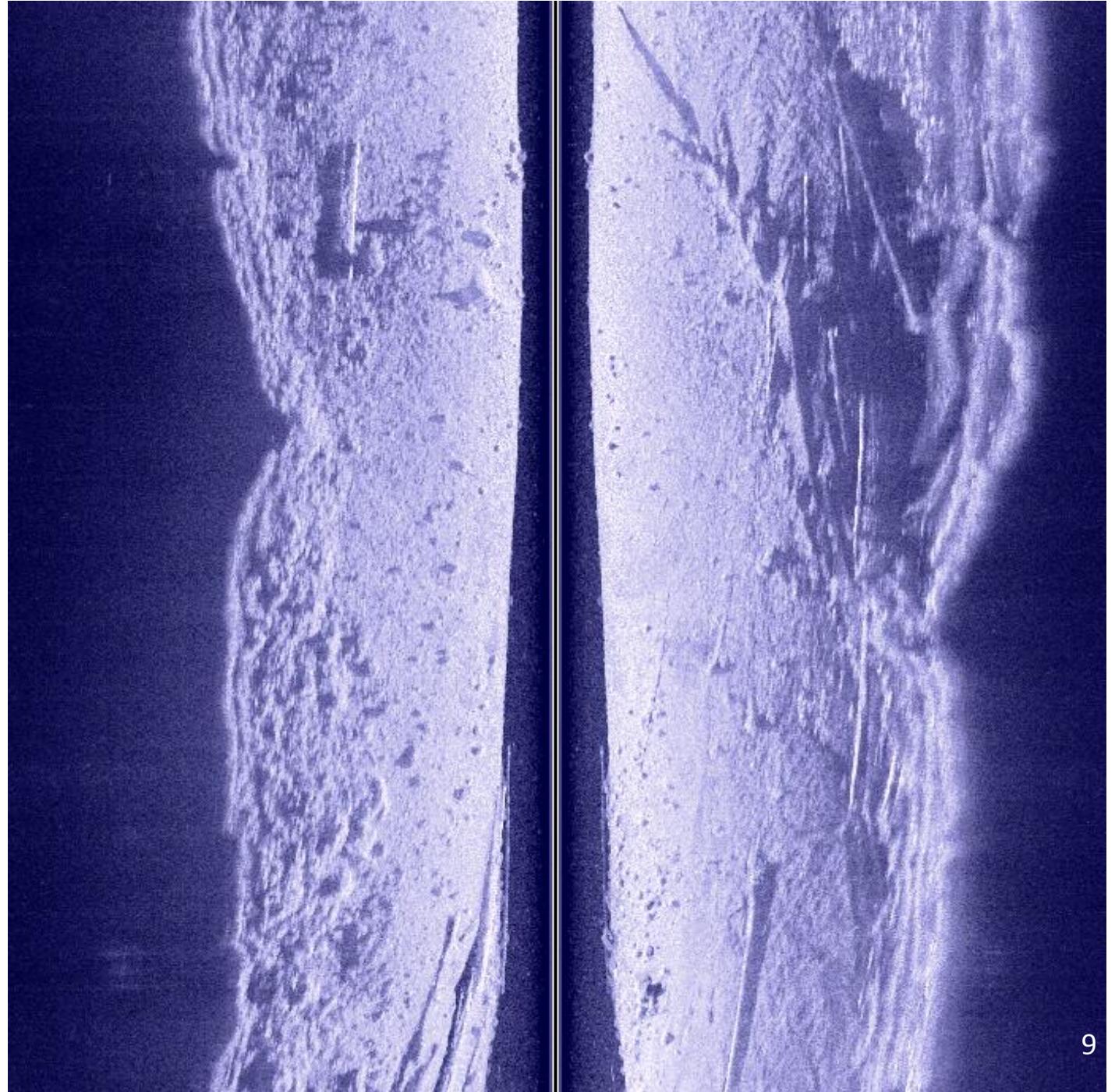
Prop-wash effects



Forward mount transducer

The differences are striking to say the least! Using a forward mounted transducer the right hand side of the image is now perfectly clear, and similar in quality to the left side. Low and behold, a nice cache of deadhead logs and other woody debris is now visible in the upper right corner of the image. This cache was invisible to us when using the rear mounted transducer.

No Prop-wash effects



Rear mount transducer

To drive this point home, let's examine another example. Here's a field photo of a reach of stream scanned at higher flow using both a rear and forward mounted transducer. During the surveys the boat passed to the left of the mid-channel cypress tree. To the right of this tree is a deadhead log.

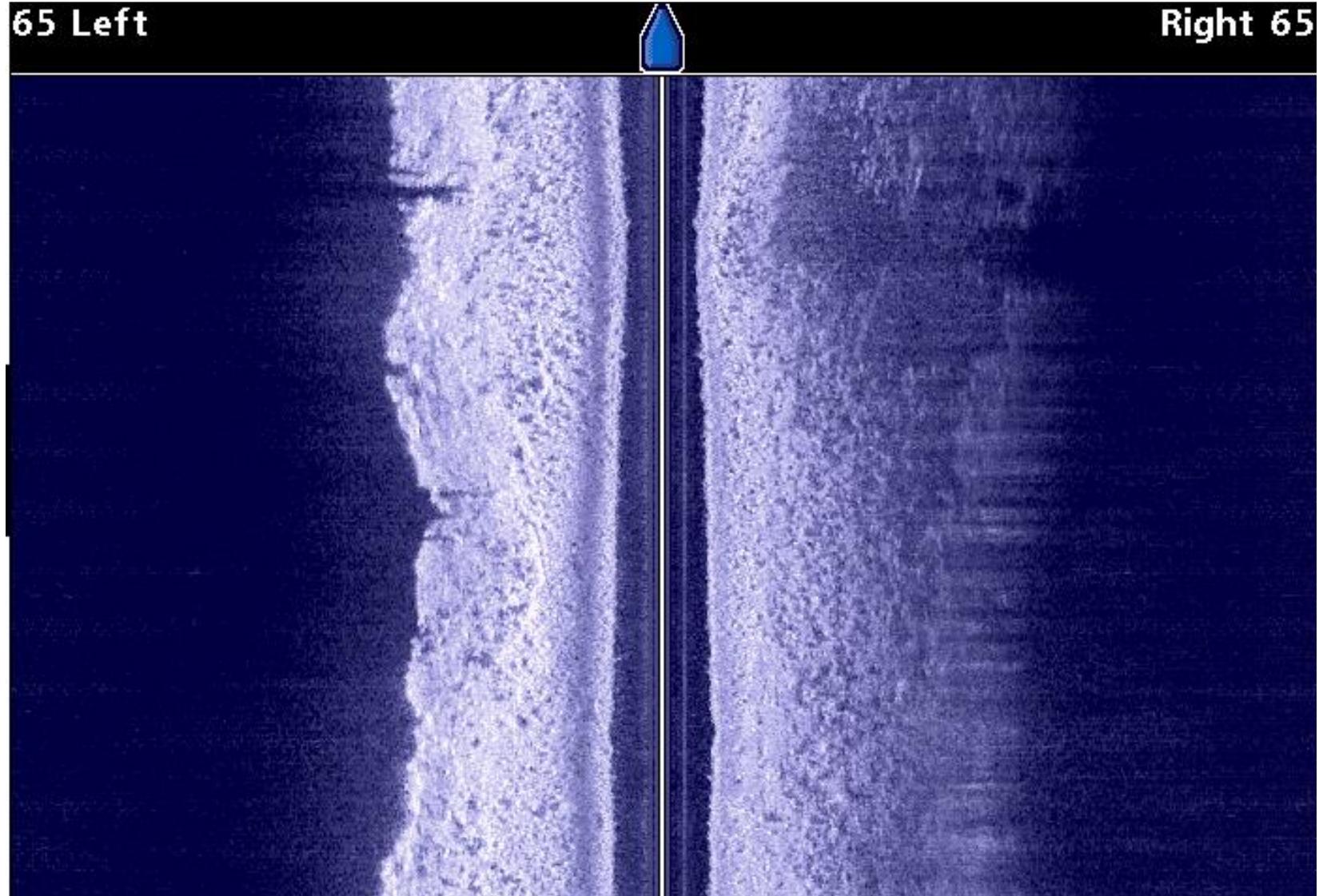
Prop-wash effects



Rear mount transducer

Here is a single raw image captured from this reach with the rear mounted transducer. In the upper right corner of the image is where the cypress tree and deadhead log were located. These two prominent features are barely visible.

Prop-wash effects

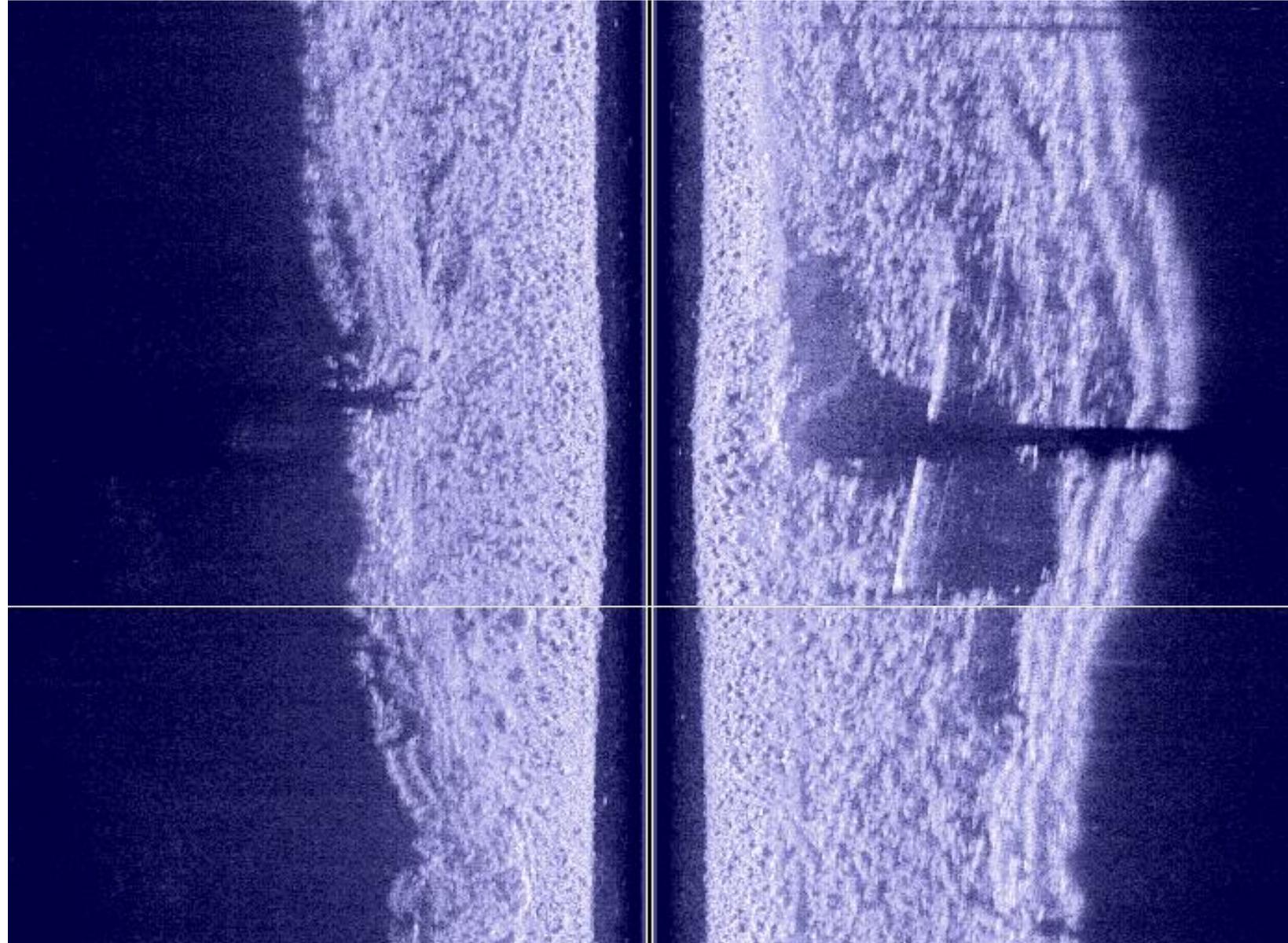


Forward mount transducer

Here is the imagery produced using a forward-mounted transducer. The improvement in image quality is extraordinary. The cypress tree and its sonar shadow are clearly visible, and so is the large deadhead log that was resting between the tree and the right bank. The right bank is now clearly discernible.

We strongly recommend to all sonar operators to consider building a custom mount that enables the forward placement of the transducer. We simply would not consider capturing sonar imagery for mapping purposes any other way.

No Prop-wash



Go with the flow

Since we are on the topic of minimizing turbulence for the sake of producing the highest quality imagery, let's discuss a few more best practices. A very relevant question having to do with survey execution is whether to head upstream or down. We have found that heading downstream produces higher quality imagery, and believe this result is attributable to less turbulence around the transducer when going with the flow of the river rather than pushing upstream against it.

There are a couple of negatives associated with going downstream, although they do not outweigh the benefits. One downside is that you don't get to see what is around the next corner. In a swift, confined stream, this might be a hazardous situation. We recommend launching the boat at a downstream ramp and heading upstream to your survey starting point. Along the way you can take mental notes on the condition of the stream and any navigational hazards. Swift decisions must be made when such hazards are encountered, and when the survey is underway it's best to have these things figured out. Heading upriver to start the day is always a good idea. If your motor dies you can float back to the ramp. If you encounter shallow, treacherous areas, your ability to power upstream and beyond such hazards will almost always be rewarded with successful downstream passage. The opposite case is NOT always true!

In a bend, the river will try to sweep your boat toward the outside bank. Offset this force with gradual thrust away from the bank.

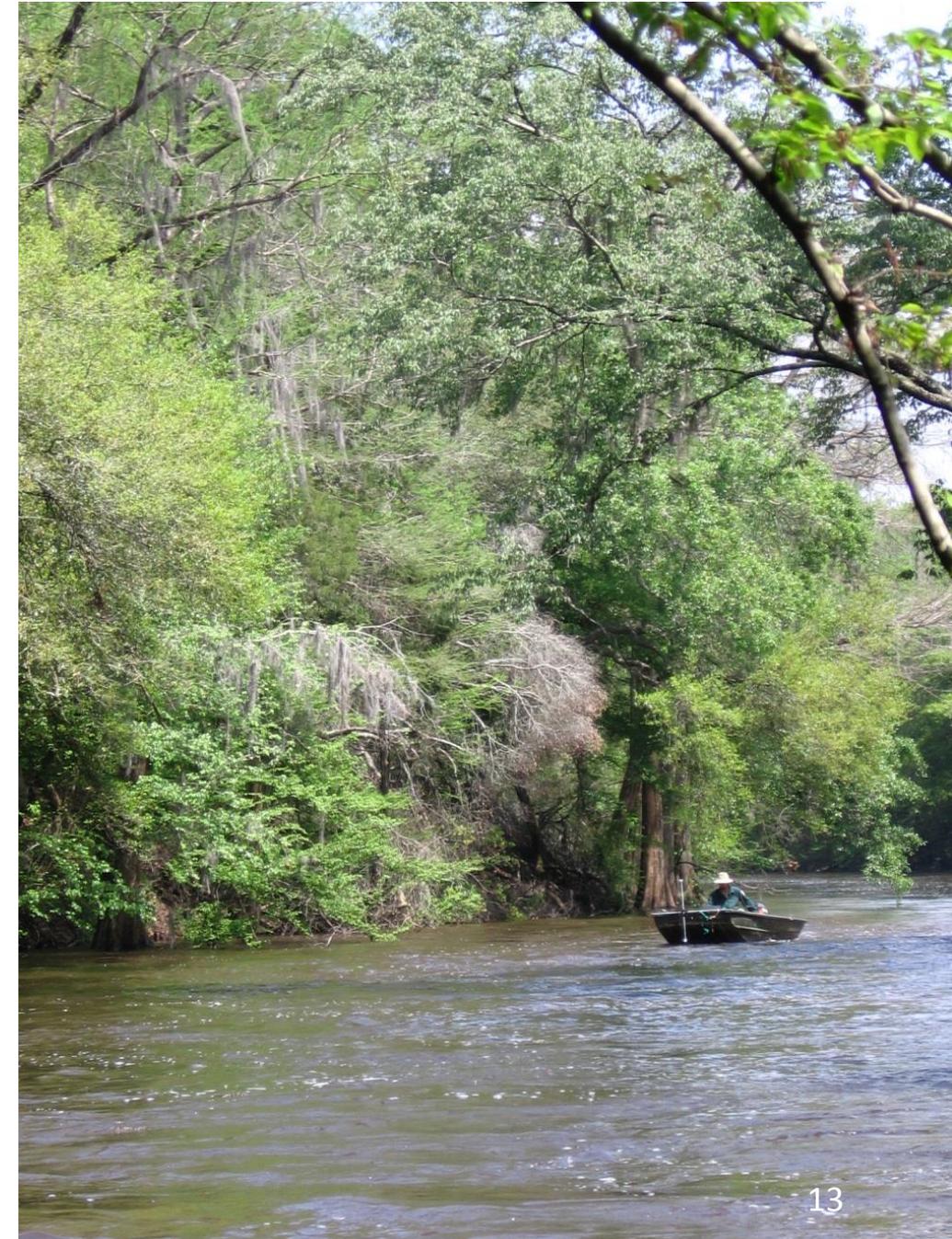
Heading Upstream or Down?

**Downstream
(usually) is best,
but Why?**

**Less turbulence
around
transducer,
smoother ride=
higher quality
images**

**Go with the
flow!**

**Caution-
Navigation can
be treacherous**



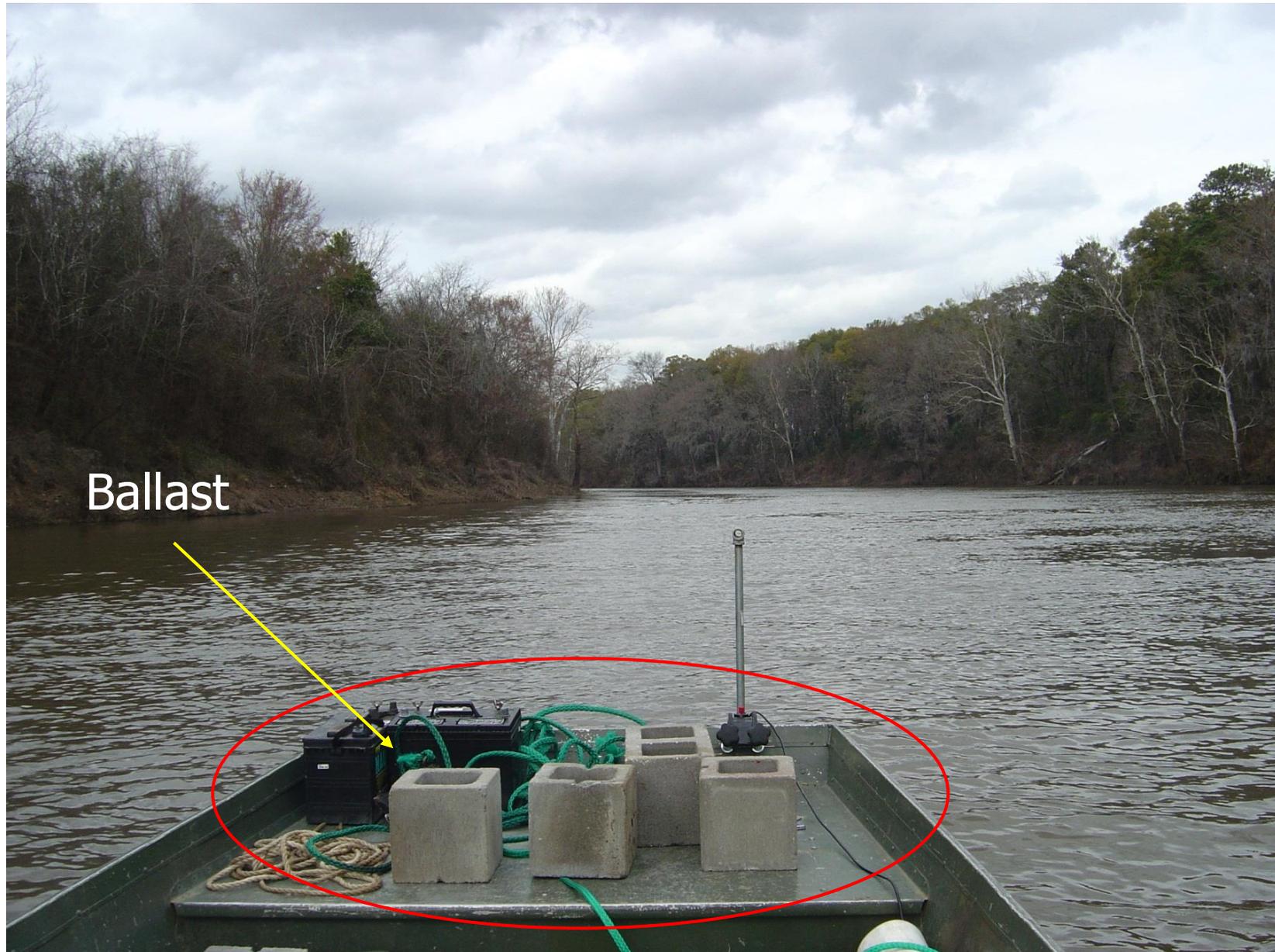
It's the little things

Another practice we highly recommend is the use of ballast to stabilize the front of the boat. By loading the front end, the effect of minor wave action on the pitch and roll of the boat is minimized. This added stability pays dividends in enhanced image quality.

Lots of things that are hanging around in your garage can be used as ballast. We have used cinder blocks and old marine batteries as shown here. The downside is lugging around all this extra weight. One day it dawned on us that we could take an old, oversized cooler, put it on the front end of the boat, and fill it with a pail or a bilge pump before initiating the survey. When finished, the water weight can simply be dumped overboard.

Let's face it, we're trying our best to produce high quality imagery with a \$3000 piece of equipment. Every little thing, however insignificant, might contribute to the production of high quality imagery throughout a survey. If you have a crew member on board, you might also want to avoid having this person up and moving around the boat during the survey. Boat stability is a virtue worth pursuing.

Ballast to stabilize bow



Ballast

How fast or slow?

We're on a bit of a tangent now, and will return to sonar equipment in a moment. A common question to address at this point is what speed to head in the downstream direction? Typically speeds between 3.5 and 6 mph produce the best imagery. Of course, the boat has to be moving to produce an interpretable image, but moving too fast is not a good idea. If too fast, the gap between signal returns from the bottom will be too large and resolution will suffer. (For this reason we also set the ping rate on our units to 10- the highest rate setting available. The default is AUTO, but we do not know what AUTO actually does).

In practice, speed in a lotic system will be partly determined by surface water velocity. To maintain thrust and position in the channel, the survey vessel will have to be moving just a bit faster than the stream. In swift reaches, you may actually find that thrust is used minimally to maintain position as the stream carries the boat along at a rate ~6-7 mph.

In lentic environments, the rate of forward progress will be fully controlled by the boat operator. It is possible to travel more slowly (~3.5 mph) while scanning a lake or reservoir. Bear in mind, however, that the slower the boat goes, the longer it takes to complete the survey.

Boat Speed

Side imaging performance is best between 3.5 - 6 mph.



Image courtesy of 123rf.com

The best boat speed to use may depend on the side range selected.

Slower speeds are good for longer ranges (wider streams), while faster speeds can be used at shorter ranges.

Depends on fortitude

The maximum range, or distance that can be surveyed in one day is around 50 km. After 6 or so hours on the water, driving the boat and pressing buttons, mental fatigue may set in. The pace of 5 mph is quite leisurely, and staying focused on the survey demands mental fortitude.

*This range (50 km) can and has been exceeded by our crew of two sonar techs aboard one boat (Reuben Smit and Tanner Williamson). Each would drive and operate the survey boat for a few hours then trade off with the other. Biological necessities were taken care of while the survey was underway. This committed approach yielded continuous, unbroken survey transects that extended for many, many miles. As you will learn later, there are significant benefits to capturing long continuous segments when it comes to image processing.

How far can we go in 1 day?

At 5 mph (8 kmh), it is possible to survey approximately 30 miles (50 km) in a typical day.



Back to the gear

We have discussed the placement of the control head and transducer, let's discuss the use of the Global Positioning System (GPS). The GPS is necessary to provide coordinates for image capture locations (WAYPOINTS) and the breadcrumb track file representing the boat path (TRACKPOINTS). Given that we use both files to properly georeference imagery, the positional accuracy of the GPS is very important. That said, the stated accuracy of the WAAS-enabled Garmin GPS map76 series is 3-5 meters. We find this accuracy quite suitable for our purposes.

The HSI combo systems come with a puck-like GPS receiver. This receiver will provide coordinates for the images, and the control head can store a trackpoint file. Working with the control head trackfile, however, is a bit more cumbersome than working with an external GPS like the Garmin GPSmap76 series. More importantly, if the sonar operator forgets to manually save the trackfile before powering off the control head at the end of a survey, the trackfile will be lost altogether. At the end of a long day in the field, the risk of this happening is quite real.

We advise sonar operators to consider substituting a handheld unit like the Garmin GPSmap76 series. Many agencies and institutions use this type of GPS receiver, and they are relatively inexpensive (<\$300).

GPS Connection

- GPS accuracy has a global influence on the end products of sonar mapping. GPS accuracy is important!
- HSI Combos come with a GPS receiver (but you CANNOT easily extract and work with the trackfile from control head. If you power down before saving track it is deleted)
- So, we substitute a hand-held GPS receiver that provides coordinate data to control head, and captures track file
- Position GPS receiver near the transducer

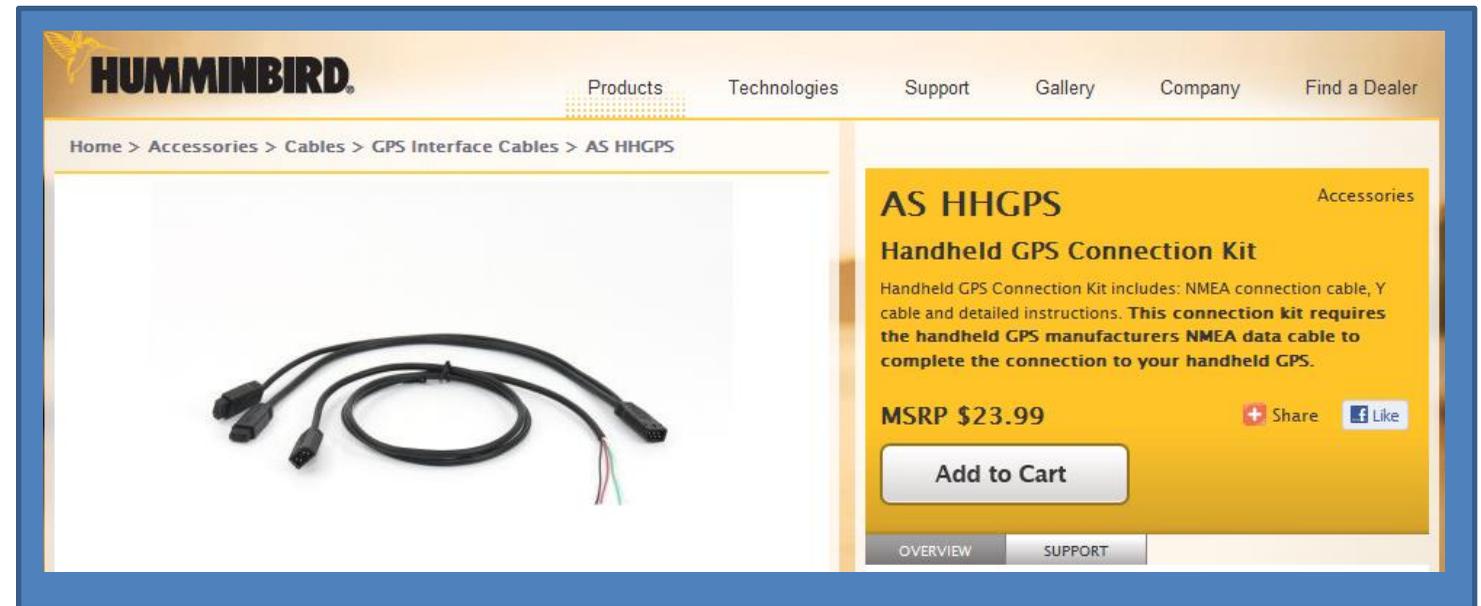


2 Cables are needed

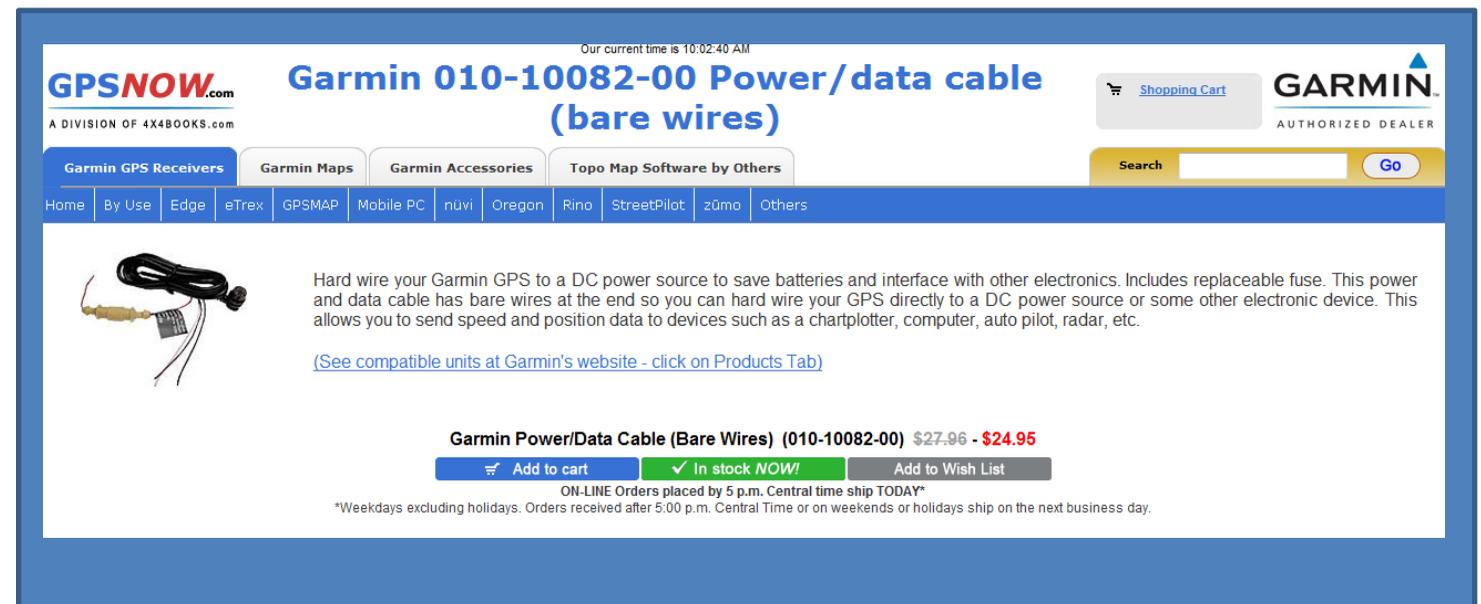
To substitute a Garmin or other handheld GPS unit for the out-of-box receiver you will need to purchase two accessory cables. The first cable is sold only by the Humminbird company through their website. It is called the AS HHGPS cable- Handheld GPS Connection Kit (\$24). The cable has the plug that inserts into the back of the control head on one end, and 4 bare wires on the other.

The other cable will depend on the type of GPS receiver you are integrating. Our Garmin GPSmap76CSx units require a power/data cable such as shown on the lower right. The connecting plug that inserts into the back of the Garmin is a round, 4-pin plug. The harness includes 4 bare wires, two of which are power wires and the other two are data wires. The only trick is matching the proper wires up. Once wired properly, the Garmin GPS will be able to draw its power from the same power source as the control head, and the control head and GPS will be able to communicate (send data back and forth) with each other. During the wiring process we splice a long (~14 foot) section of 4-strand trailer harness wire between the control head GPS accessory cable and the Garmin power/data cable that lengthens the line and enables us to put the GPS in the front of the boat, next to the transducer mount.

How to swap GPS receivers



The screenshot shows the Humminbird website's product page for the AS HHGPS Handheld GPS Connection Kit. The page features a navigation menu at the top with links for Products, Technologies, Support, Gallery, Company, and Find a Dealer. The breadcrumb trail reads: Home > Accessories > Cables > GPS Interface Cables > AS HHGPS. The main image shows the black cable with a round 4-pin connector on one end and four bare wires on the other. To the right, the product title is "AS HHGPS Handheld GPS Connection Kit" with a sub-label "Accessories". Below the title, a description states: "Handheld GPS Connection Kit includes: NMEA connection cable, Y cable and detailed instructions. **This connection kit requires the handheld GPS manufacturers NMEA data cable to complete the connection to your handheld GPS.**" The MSRP is listed as \$23.99, and there are social media share buttons for Share and Like. A prominent "Add to Cart" button is visible, along with "OVERVIEW" and "SUPPORT" tabs at the bottom.



The screenshot shows the GPSNOW.com website's product page for the Garmin 010-10082-00 Power/data cable (bare wires). The page features a navigation menu at the top with links for Garmin GPS Receivers, Garmin Maps, Garmin Accessories, and Topo Map Software by Others. The breadcrumb trail reads: Home > By Use > Edge > eTrex > GPSPMAP > Mobile PC > nüvi > Oregon > Rino > StreetPilot > zūmo > Others. The main image shows the black cable with a round 4-pin connector on one end and four bare wires on the other. To the right, the product title is "Garmin 010-10082-00 Power/data cable (bare wires)". Below the title, a description states: "Hard wire your Garmin GPS to a DC power source to save batteries and interface with other electronics. Includes replaceable fuse. This power and data cable has bare wires at the end so you can hard wire your GPS directly to a DC power source or some other electronic device. This allows you to send speed and position data to devices such as a chartplotter, computer, auto pilot, radar, etc." A link is provided: "(See compatible units at Garmin's website - click on Products Tab)". The MSRP is listed as \$27.96 - \$24.95. There are buttons for "Add to cart", "In stock NOW!", and "Add to Wish List". At the bottom, a note states: "ON-LINE Orders placed by 5 p.m. Central time ship TODAY*" and "Weekdays excluding holidays. Orders received after 5:00 p.m. Central Time or on weekends or holidays ship on the next business day."

How to obtain trackfile

The trackfile to obtain during a sonar survey will have coordinates for observations along the survey route, and a depth reading at each point. Depth data comes from the control head to the GPS device **once NMEA communication has been turned on for the Humminbird control head and the GPS.** To enable communications from the Garmin GPSmap 76CSx (*these steps may differ with other GPS units) you must go to the GPS Setup menu, select Interface, and set the Serial Data Format to NMEA In/NMEA Out. To set up a Garmin GPSmap 76CSx for recording a trackfile during the survey the following steps must be taken: enter the Tracks menu and turn the Track Log on, go to Setup and set the Record Method to Time, set the time interval as desired (we use a 3-second interval).

At the beginning of a survey we access the Track Log and Clear all pre-existing trackpoints. The memory is empty and ready to start logging trackpoint coordinates and depths every 3-seconds.

What is the importance of the 3-second trackpoint interval? You may be tempted to set the interval to 1 second to obtain more depth data, but BEWARE! At a 1 second interval, the internal memory of the GPS will fill very quickly. We have found that a 3-second interval produces a lot of depth data, but does not completely consume all of the available memory during a full-day survey. Bear in mind, if you stop for a break, your device will continue logging points if it remains ON.

GPS Trackfile (TRACKPOINTS)

- Enable NMEA output to establish communication with control head. This provides the useful option of recording depths at each trackpoint= more depth data.
- Set up tracklog to record a point at frequent intervals (eg. every 3-sec).



How to set range

Although there are many settings that can be manipulated via the control head, the range setting is one that has global influence over image quality as discussed at length in previous chapters. The range setting is accessed via the 1st menu from the side imaging view. The range used during imaging will depend on system size and a variety of survey objectives. To determine the range(s) for a project, we typically first examine streams in Google Earth and make measurements with the ruler tool to assess typical channel variability. If making a single pass to cover the entire wetted channel of a stream, we will select a range setting that is slightly larger than mean stream width to accommodate for natural channel variability. On the water you may find it useful to spend some time practicing with different range settings in a reach with the goal of identifying the ideal setting for your study reach.

If surveying a long reach of stream, expect that changes in width will occur as you progress downstream that will necessitate an on-the-fly range change. A good practice is to record the 1st image waypoint number following a change in range setting. Each time the range is changed, one geoprocessing segment ends and a new segment begins (this concept will make sense when we get to geoprocessing). For now, suffice it to say that we want to be conservative with the number of range changes undertaken during a survey. That is why we opt for a setting that will encompass typical channel width variability.

Critical Setting - Range

Range

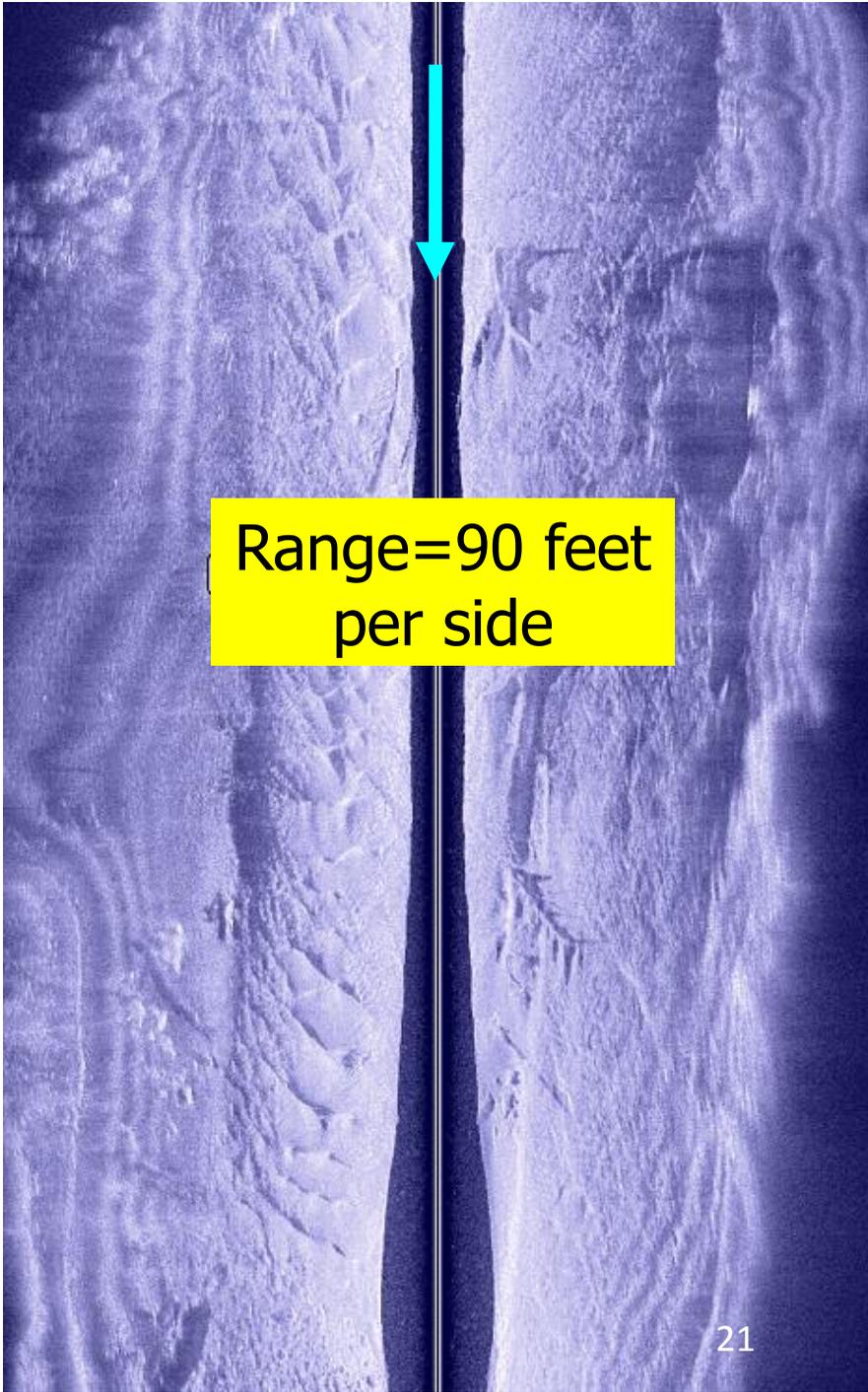
- Set to encompass typical channel width variability
- Assessment Tools-
 - 1) Examine Google Earth maps
 - 2) Carry rangefinder in field
 - 3) Trial and Error



Working with range

In this example, the ideal range setting of 90 feet per side captured imagery of the entire wetted channel in most reaches, yet unusual areas like the mouth of this small backwater were too wide to be captured at this range. As we approached the backwater, the imagery reveals that the right bank drifted out of view and only returned into view in the lower left corner of the image after passing beyond the wide spot. Although the wetted area of the backwater was not imaged, we would not have attempted a range change on-the-fly to compensate for this short-term widening for the sake of maintaining a continuous, uninterrupted segment of data for processing. This area essentially represents "missing data" beyond the sonar range of the survey. We can either quantify and report the missing data in our map products, or choose to return to the backwater with a mini-survey to fill in the data gap.

Assess Stream Width



Capturing imagery

Sonar imagery can be captured two ways with the Humminbird SI system, but cannot be captured both ways simultaneously. The sonar operator must therefore choose only one of the available methods for image capture. Recall that we are teaching only one method here, and this method requires the capture of screen snapshots.

1) Screen Snapshot

Digital Image and Waypoint
Captured Simultaneously

*Feature must be turned on from
Accessories menu tab to enable
screen image capture*

2) Sonar Recording

Continuous Sonar "video"
and streaming GPS data
captured, stored in .son file

2 Ways to Capture Imagery



Creating a snapshot image

Capturing a sonar screen snapshot is very straightforward. The screen snapshot option must first be enabled via the control head menu. Once enabled, a screen snapshot will be created every time the MARK button is depressed. Each time a snapshot is captured, a set of coordinates (i.e., a waypoint) to reference the image are simultaneously captured. Waypoints are stored in the internal memory of the control head, not in the Garmin GPS. The sonar images are stored as .png image files on the SD flash card that must be inserted into the control head. (The system does not come with an SD card- you must purchase one and install it). Conveniently the waypoint and image are given the exact same ID number.

In order to retrieve the waypoint data from the control head, the data must be exported to the internal SD card via the Export All Nav Data option under the NAV tab of the menu (the GPS must also be attached and powered ON during data export, for unknown reasons).

The control head can only store a certain number of waypoints (e.g., 3000 waypoints for the 1100 series units). Thus, when the memory is full, an error message will appear to indicate that no additional waypoints can be stored. At this point, the sonar operator can only export the nav data to an SD card, remove this card, Delete All Nav Data from the control head, insert a new, blank SD card (*not containing a preexisting Nav data file), and resume the survey.

The Screen Snapshot

When you press button, a waypoint and sonar image are simultaneously captured!

- **Waypoint is stored in the control head**
- **Sonar image (PNG) stored on SD flash card**
- **Waypoint and image are given the same ID number**

***Caution- 1100 series control head can store a max of 3000 waypoints**

The snapshot image

Here is an example of a snapshot image created with a 900-series SI system. The 900-series systems place the information bar on the left side of the sonar screen, and the 1100-series has the information bar along the bottom. This information bar can be set up to display different information at the time the image was captured. We like to display the coordinates of the image (i.e., the image waypoint) in the information bar just in case the waypoint file is lost or corrupt (although this has never happened in our experience).

The coordinates reference a single location in the image- the point directly behind the little blue boat icon at the top of the image. In other words, these decimal degree values are the real-world coordinates of the midpoint of the uppermost row of pixels in the actual sonar image.

Image S06718

**Waypoint
coordinates**

Depth |ft| 85 Left

9.4

N 31.29910°

W 084.48528°

9:31:34 AM

4/08/08

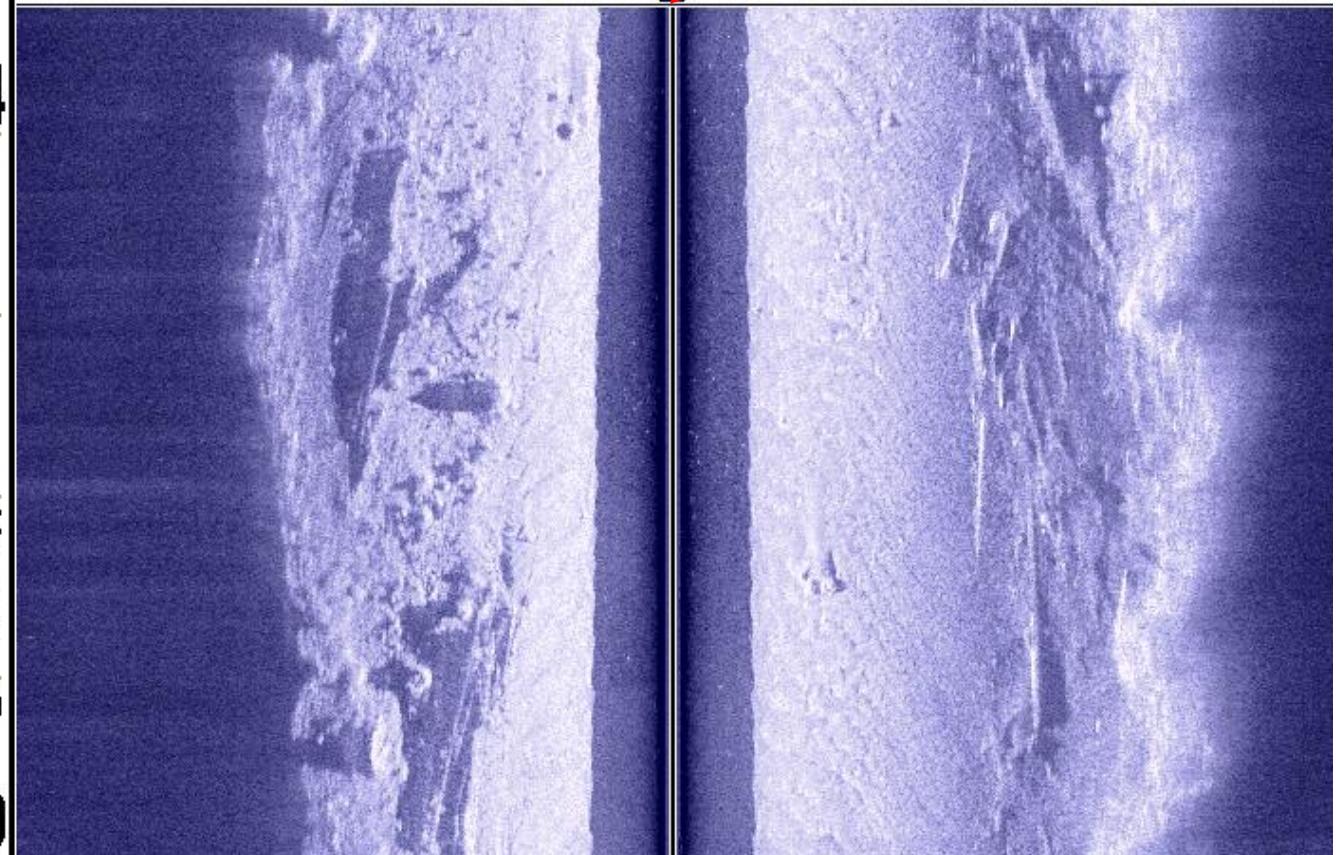
Course |°t

157

Speed |mph

4.9

Right 85



Role of the interval timer

To semi-automate the capture of consecutive, overlapping sonar images we employ an interval timer. The timer is programmed to repeatedly countdown a fixed number of seconds (i.e., the interval). At the end of the countdown an alarm is sounded that indicates when to capture the next sonar image. The Seiko S057 interval timer is a model that works well for us. This timer conveniently provides a beep during the final 3 seconds of the countdown, preparing you for the alarm. Many folks seem to be troubled with the fact that a button must be repeatedly pressed to capture the imagery in this method. Does everything in this world have to be automated for us to be content! Perhaps someday Humminbird will program a setting that allows the user to automate screen snapshot capture at specified time intervals. Until then, keep your index finger in good shape.

The topic of determining the screen clear rate, and the appropriate time interval to use to capture consecutive images that contain a small amount of overlap, is described in detail in the Appendix of the Sonar Image Geoprocessing Workbook that accompanies Session III of this guidebook. In the Appendix we provide a chart that can be used as a crude guide to selecting the appropriate interval. We have recently determined that the screen clear rate may differ among units, and also may within the same unit as conditions affect the processing speed of the internal control head computer. Therefore, this chart should be used a guide only, and field testing should be used to estimate the empirical screen clear rate in the field.

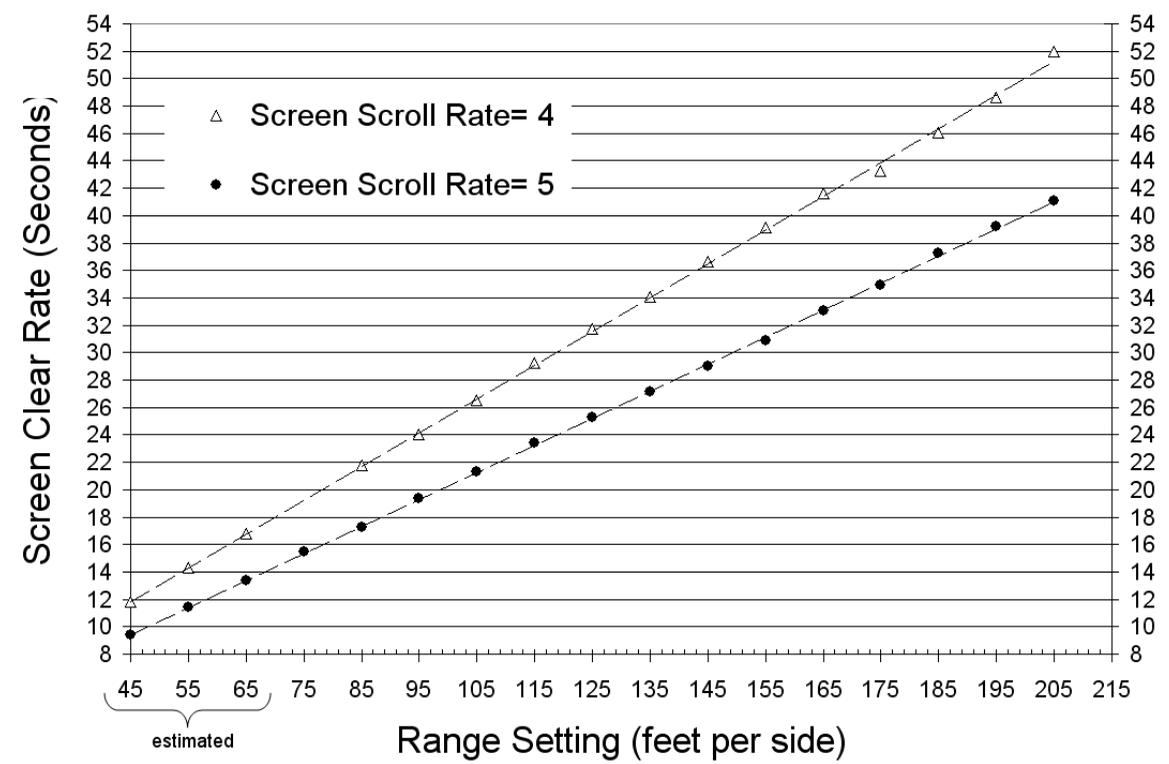
How to capture consecutive, overlapping waypoints

SEE Appendix in Geoprocessing workbook for details

Seiko S057 Interval timer



Sonar screen time-to-clear estimates (used to set interval timer) for HB 1197c SI



Sonar video recordings

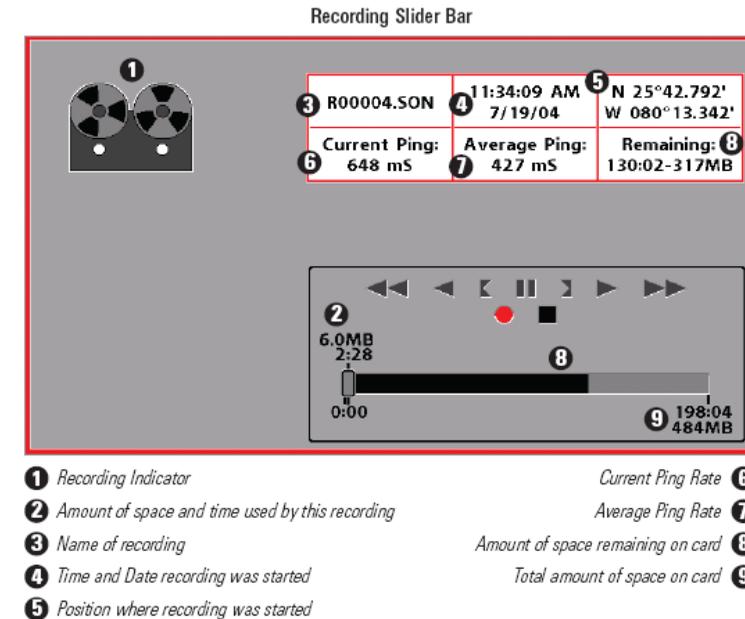
As we have mentioned, sonar imagery can also be saved in the format of a "video" file. This file, saved to the control head, has a .son extension. In the very early days of the Humminbird SI system, this file format could not be converted for use in available processing software packages. During this time, .son sonar video files could only be played back on the control head. It wasn't long before several free converter programs appeared online that could transform the .son format to .xtf (Extended Triton Format). The .xtf format files can be played back on free software packages on a desktop computer (e.g., YellowFin Viewer), and can be processed into rectified sonar image map layers (mosaics) using several commercially available software packages that range in cost from a few hundred dollars to several thousand dollars.

The sonar video file is without a doubt much simpler to create. A video file is initiated and ended via a sonar recording menu on the control head. In other words, the operator does not have to repeatedly press the MARK button to capture sonar imagery. Perhaps it seems like silly work, yet the results are well worth the effort. During development we had no idea of the true benefits of the snapshot approach. We have since put this approach to the test in a variety of inland, freshwater systems, and have validated and published evaluations of products of this method. The merits of the snapshot approach will be expounded upon in Session III on geoprocessing.

Sonar Recordings

Viewing options

- 1) Playback on the control head
- 2) Convert .son file to a format (eg. XTF) that can be played-back using other software (eg. YellowFin Viewer). Conversion programs available online via Humminbird forums - search "Son2XTF" or "HBSI sonar data file converter"
- 3) XTF file can be geoprocessed into mosaics with other software (e.g., Dr. Depth, SonarTRX, Hypack)



Highlighting a recording: You can scroll through the whole list of recording icons available in the Snapshot and Recording View using the 4-WAY Cursor keys. The highlighted icon will be surrounded by arrows, and a green play triangle will appear to its right.

Media for data storage

To save sonar screen snapshots, video recordings, or navigation data exported from the control head, you must purchase and install an SD memory card. The current screen snapshot file format is .png. These files are quite small, yet retain full image quality. A popular question is how many cards to carry and what size? Many sonar snapshots can be stored on a single 2 GB card. The likelihood of filling an empty 2 GB card with snapshots in 1 day is extremely low. We estimate that a 2 GB card could hold ~10 hours of continuously captured images (@ 3-second interval). We recommend that sonar operators carry 2 of these 2 GB cards with them on the water. The second card may come in handy if a dump of the waypoint data from the control head is necessary to free up internal memory on the device (this situation was discussed previously).

Memory Cards

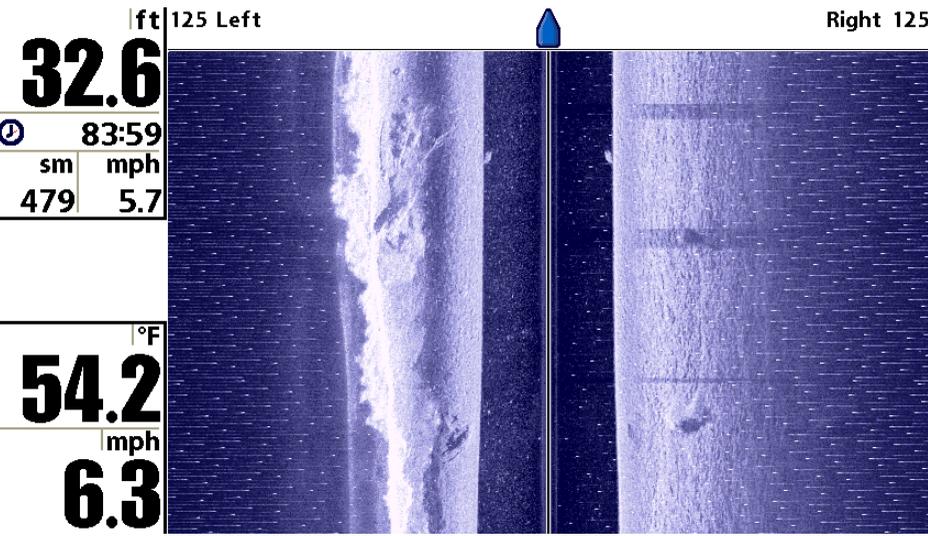
- **Storing images requires an SD Memory Card**
- **How many cards should I carry?**

2 2GB cards will store all images captured in 1 Day



Using other sounders

The use of other onboard electronics may interfere with sonar imaging. One day we decided to operate a second, down-looking sonar device while operating the side scan sonar. The effect was less than desirable. For some time after we thought it impossible to operate 2 sonar systems on the same boat without experiencing interference of this sort. However, we recently deployed 2 different high frequency side scan systems (Humminbird SI in front, EdgeTech off the side) and did not find any trace of interference in the imagery. Sometimes you just don't know 'till you try it!



This could be a problem



The time has come

Well, we have covered a lot a ground in preparation for this moment. Flows are right, gear is set, and we have done some field testing. We're ready for the fun part- the sonar survey. It's nice to have a crew member or two on board to document the experience.

There is one point to make above all when it comes to the sonar survey- **DON'T SETTLE FOR CRAPPY SONAR DATA!** The field survey part of a mapping project is a small fraction of the total time investment. A great deal more time is going to be spent actually producing map products from the raw data obtained during the field survey. Be critical of your imagery. Use examples provided in this guidebook for reference and comparison. If conditions are not ideal, and your imagery does not look as good as can be, spend time adjusting your set up or technique or target better imaging conditions with a re-survey. You won't regret it. Our mantra is- Obtain the best sonar imagery possible, then proceed.

Conduct Sonar Survey!



Riverscape habitat data

If you have the luxury of a second crew member on board the survey vessel, this person needs a job besides bird watching and providing moral support. With another handheld GPS device, such as a Trimble Recon, a variety of data can be collected along the survey route. Riparian features can be logged and described, and notes can be made to assist with interpretation of sonar imagery during mapping.

Additional Considerations for Sonar Missions

Gather above-water habitat data

2nd Crew member can, for example

- Operate a second GPS unit (eg. Trimble Recon) to mark various features (eroded banks, bankside structures, docks, etc.)
- Operate a GPS-enabled digital camera to obtain photos



Document the riverscape

We have found great utility in equipping a crew member with a GPS-enabled camera. The Sony Cyber-shot DSC-HX5V camera is one we have used to provide georeferenced images of the riverscape. (This model may no longer be available). When this camera is turned on, it begins to establish connectivity with available satellites for a GPS lock. Once connected, the camera can shoot any field object or feature and simultaneously capture a set of coordinates for the camera's real-time position in addition to a compass heading indicating the direction the camera was pointing!

GPS & Compass enabled camera

Sony Cyber-shot DSC-HX5V

Camera Reviews > Sony Cameras

DSC-HX5V Overview Optics Exposure Performance Specs

10.20 Megapixels	10.00x zoom	3.0 inch LCD
------------------	-------------	--------------



Basic Specifications	
Resolution:	10.20 Megapixels
Lens:	10.00x zoom (25-250mm eq.)
Viewfinder:	LCD
LCD Size:	3.0 inch
ISO:	125-3200
Shutter:	30-1/1600
Max Aperture:	3.5
Dimensions:	4.1 x 2.3 x 1.1 in. (103 x 58 x 29 mm)
Weight:	7.1 oz (200 g) includes batteries
MSRP:	\$349
Availability:	03/2010

2-5 meter positional accuracy

\$180-250 online

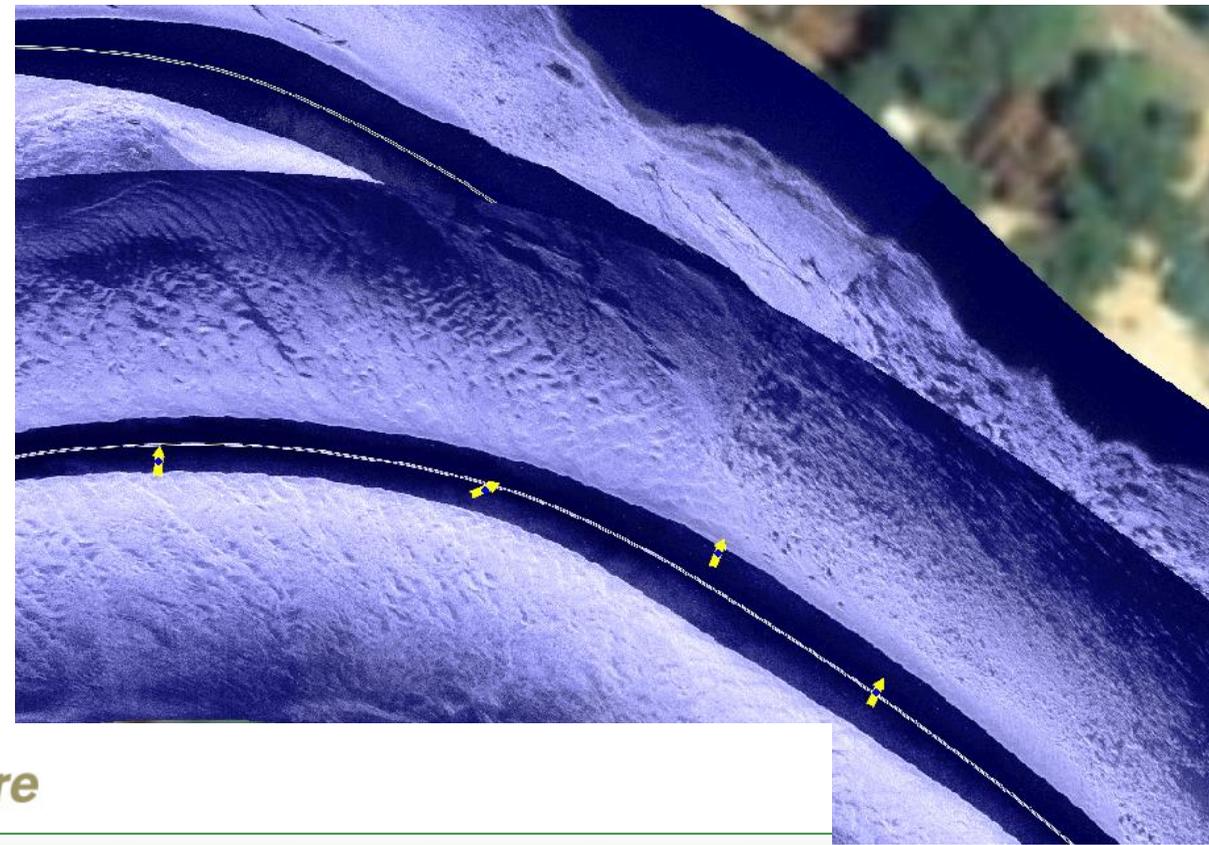
Extracting image data

A free program called BRSoftware EXIFextracter can be used to create a file that contains the photo image number, the latitude and longitude, the compass heading, and other information (see table below). We can then use the coordinates to create a set of points (arrow icons) in our map project that represent the capture locations of each photo. The set of digital photographs can be hotlinked to the points for instant access with the click of the mouse, and the arrows can be oriented in the direction the camera was facing when the picture was created. How awesome is that! For directions on how to hotlink images just contact us.

Extractable EXIF (exchangeable image file format) tag information

	A	B	C	D	E	F	G
1	File	Latitude	Longitude	SDate	STime	SDdir	
2	DSC00005.JPG	31.791128	-82.973992	2/15/2011	9:53:05 AM	39.25	
3	DSC00006.JPG	31.791096	-82.971685	2/15/2011	9:55:49 AM	115	
4	DSC00007.JPG	31.787783	-82.968307	2/15/2011	10:05:19 AM	82.75	
5	DSC00008.JPG	31.785721	-82.964683	2/15/2011	10:08:17 AM	144	
6	DSC00009.JPG	31.784438	-82.962555	2/15/2011	10:10:29 AM	33.25	
7	DSC00010.JPG	31.786091	-82.959616	2/15/2011	10:12:51 AM	157.5	
8	DSC00011.JPG	31.782972	-82.956978	2/15/2011	10:15:42 AM	46.25	
9	DSC00012.JPG	31.782947	-82.956013	2/15/2011	10:16:27 AM	261.5	
10	DSC00013.JPG	31.782952	-82.955973	2/15/2011	10:16:44 AM	73.25	
11	DSC00014.JPG	31.782952	-82.95593	2/15/2011	10:17:05 AM	93.25	
12	DSC00015.JPG	31.783233	-82.954073	2/15/2011	10:17:27 AM	60.75	
13	DSC00016.JPG	31.784695	-82.949843	2/15/2011	10:19:56 AM	37	
14	DSC00017.JPG	31.784781	-82.947381	2/15/2011	10:21:55 AM	133.75	
15	DSC00018.JPG	31.784705	-82.943411	2/15/2011	10:24:44 AM	101.75	
16	DSC00019.JPG	31.786256	-82.940783	2/15/2011	10:27:29 AM	350.25	
17	DSC00020.JPG	31.786526	-82.93769	2/15/2011	10:30:36 AM	111.25	
18	DSC00021.JPG	31.786373	-82.933896	2/15/2011	10:34:09 AM	170.75	
19	DSC00022.JPG	31.786298	-82.929998	2/15/2011	10:37:12 AM	124.25	
20	DSC00023.JPG	31.784845	-82.923882	2/15/2011	10:40:54 AM	91.5	
21	DSC00024.JPG	31.783868	-82.91751	2/15/2011	10:44:45 AM	169.5	
22	DSC00025.JPG	31.78461	-82.911001	2/15/2011	10:48:54 AM	80.5	
23	DSC00026.JPG	31.786261	-82.90632	2/15/2011	10:52:06 AM	9.75	
24	DSC00027.JPG	31.787196	-82.905248	2/15/2011	10:53:05 AM	333.75	
25	DSC00028.JPG	31.787261	-82.905156	2/15/2011	10:53:17 AM	300.5	
26	DSC00029.JPG	31.787526	-82.90452	2/15/2011	10:53:33 AM	277.75	
27	DSC00030.JPG	31.787371	-82.90351	2/15/2011	10:54:25 AM	16.25	

GPS & Compass enabled camera



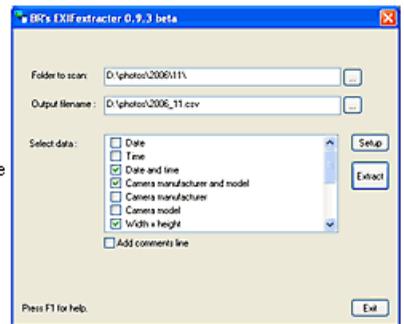
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BR's EXIFextracter

BR's EXIFextracter is a simple **freeware** program that will extract the EXIF meta information from all digital photos (JPEG files only) in a folder and saves the data in a CSV-file (Comma Separated Values). This file can be read by any program that is capable of reading CSV-files, for instance Microsoft Excel, Microsoft Access, [PixFiler](#), and most other databases.

[Download](#) BR's EXIFextracter today. It is free!

BR's EXIFextracter is still BETA test but we expect to make a final release soon. A Pro version is also planned. This will be able to extract IPTC data as well.



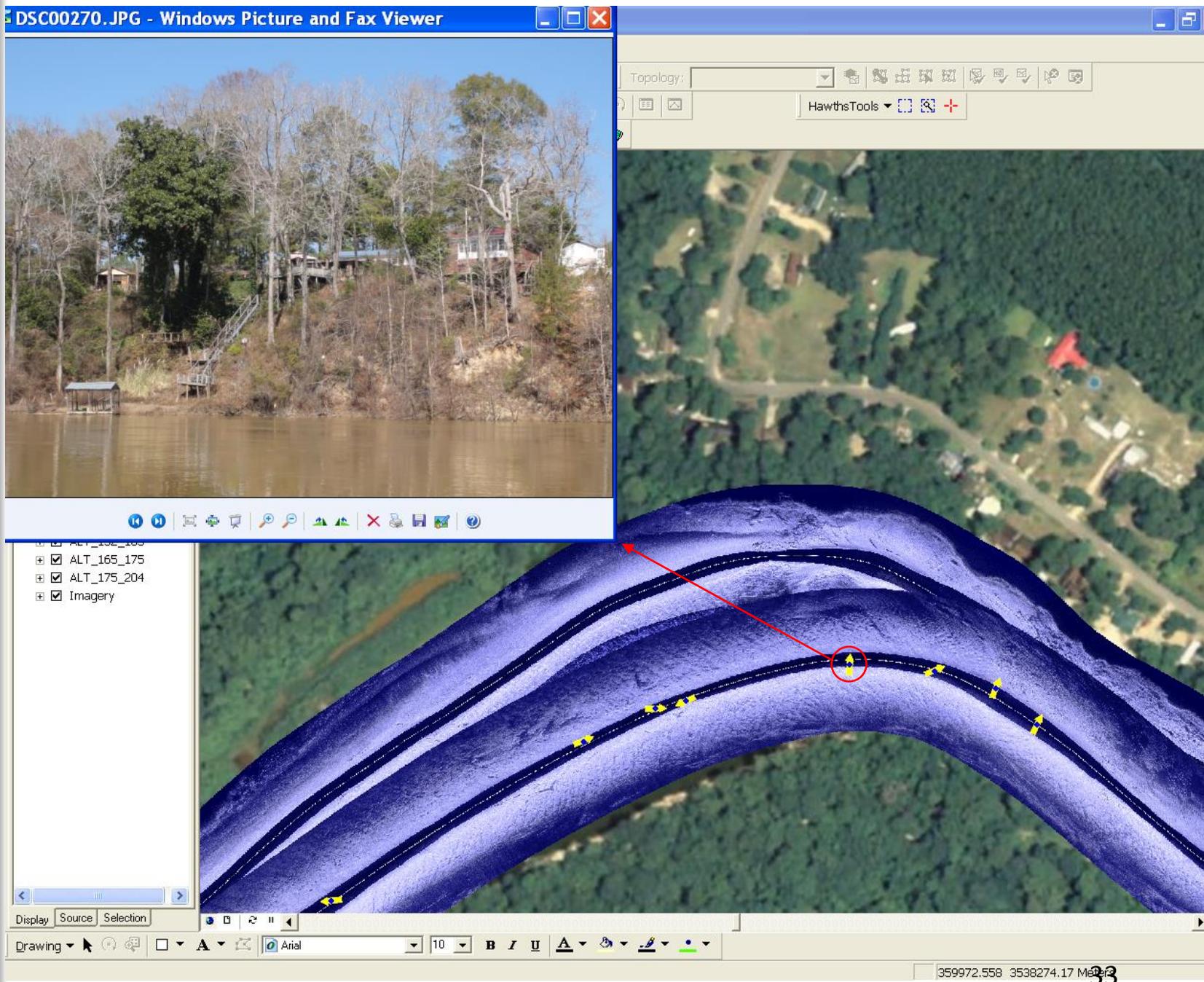
What is EXIF?

EXIF stands for Exchangeable Image File Format. This is a format used by most digital cameras store additional information about the camera settings inside the image file. This is information such as aperture, exposure time, ISO setting, exposure mode, flash usage, focal length and a lot of other more or less interesting data.

Hotlinked photographs

Once hotlinked, the riverscape photographs are retrievable by clicking on the arrow in the GIS project, as shown here. The image pops up on the computer screen. In this example we photographed a group of homes set high atop a bluff overlooking the river. It's nice to see that much of the riparian vegetation that protects this bank from erosion remains intact in this location.

GPS & Compass enabled camera



Key features of the system

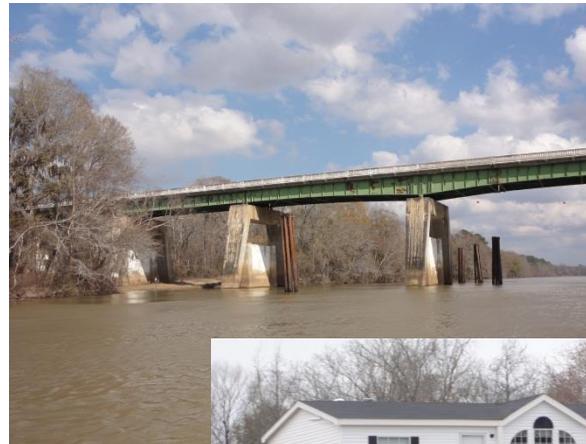
There are many features of interest along a stream that might be photo-documented during a sonar survey. Who knows how valuable a photographic record might be for future studies of riverscape change? In the near term, these photographs can be used to georeference key features of interest like exposed substrates, eroded banks or other potential impairments. We like taking a lot of photographs of our study systems, and as this program demonstrates they can be very useful for presentations and for mapping. Shooting important features in a standardized manner, incorporating photographs into the project directory, and georeferencing and establishing hotlinks to these photos takes the casual habit of photographing a study area and elevates it to the next level.

*We have considered how cool it would be to have a Google street view camera mounted to the survey boat to provide a continuous view of the riparian landscape. Anyone with Google contacts? Let us know.

What to photograph?

Anthropogenic features

- Bridges
- Waterfront homes
- Rip rap
- Docks
- Denuded banks



Natural features

- Emergent vegetation
- Rock/Bedrock outcroppings
- Shoal complexes
- Gravel bars
- Tributaries
- Anabranched channels
- Cut banks



Transferring Data

Back in the days of the original 981c, to download data you needed something called the PC Connect Kit to power the control head with two 9-volt batteries while connected to a desktop computer for a data dump. The 9-volts never lasted long, and the data transfer process often failed for unknown reasons. Data download is so easy now. You will need a program called HumminbirdPC. This program is free, and can be downloaded from Humminbird once you register your unit. Registration creates an online user account that can be checked for software updates and the like. (Registration is thus something we highly recommend). To transfer waypoint data from the control head to the SD card, you will need to execute the Export All Nav Data option found under the Nav menu in the field prior to powering down the control head and GPS. The SD card will now contain your sonar images (in the SNAPSHOT folder) and the waypoint data (a DATA.HWR file in the MATRIX folder). You then remove the SD card from the control head and insert it into your work computer. Launch the HumminbirdPC program and select the Download from SD/MMC to PC arrow under the card icon. Each time a file is downloaded, HumminbirdPC automatically saves a copy of this .gpx file to a folder, but we like to save a copy into our project directory as well. Expand the directory for this file in the menu of HumminbirdPC, and click on the waypoints tab. A table of waypoint data will appear; select, copy, and paste the data from this table into a new Excel spreadsheet.

Hardware/Software for Data Transfer

- PC Connect Accessory Kit sold by Humminbird (\$24), not needed to transfer data from 998c or 1198c HSI
- HumminbirdPC software (free from Humminbird), available upon registering your unit
- Memory Card Reader (USB port connection)



PC Connect Kit needed if using 981c only

Transferring Data

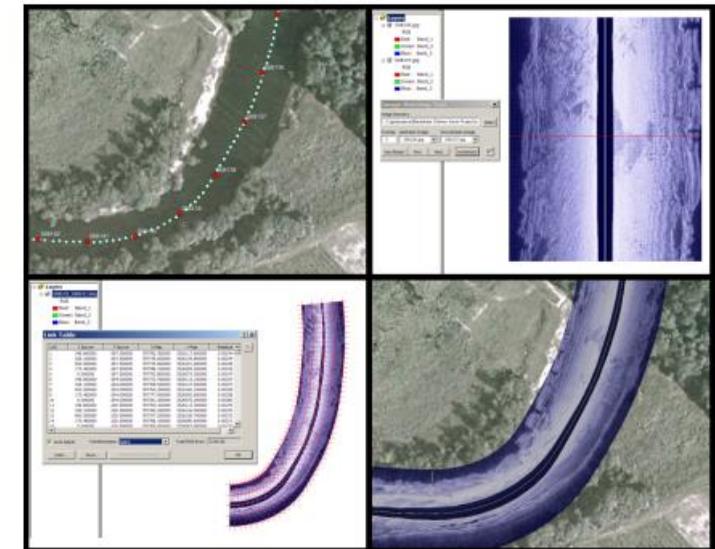
The steps following the transfer of the waypoint data from HumminbirdPC to an Excel spreadsheet are detailed in the Sonar Imagery Geoprocessing Workbook. This workbook explains how to prepare the data for import into a new ArcGIS project, and what to do following importation.

Detailed instructions on how to transfer the 3 survey data sets to a desktop computer are provided in the Sonar Imagery Geoprocessing Workbook

Data Transfer

SONAR IMAGERY GEOPROCESSING WORKBOOK

An illustrated guide to geoprocessing low-cost, side scan sonar imagery obtained with the Humminbird® Side Imaging System



Adam J. Kaiser

and

Thomas L. Litts



August 2009

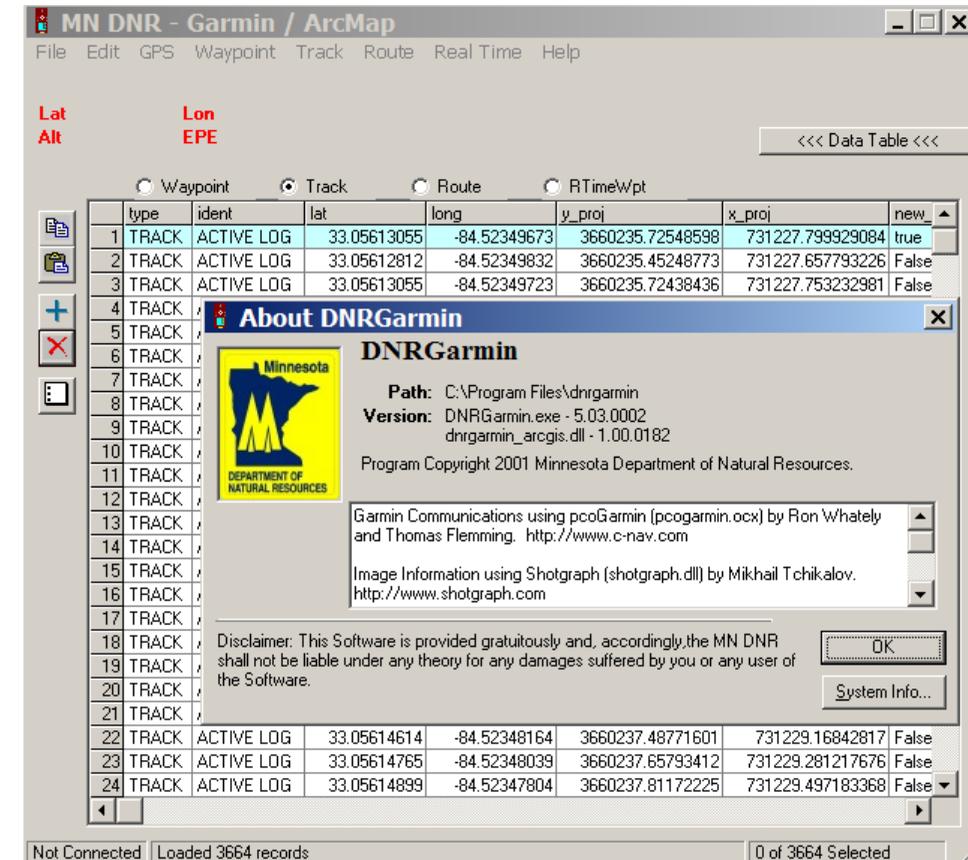
Working with trackpoints

Many are familiar with the free Minnesota DNRGarmin program (available online for download) for transfer of Garmin GPS files to a desktop computer. The process is very simple; connect the GPS to the computer and power up, launch the program, select Track and download. Although files can be saved directly as projected shapefiles, we simply save a copy of the data as a text file, and load the points into an ArcGIS project using the Add XY data option to avoid any problems with projections. (The waypoint and trackpoint data files are then projected in ArcGIS as described in the Geoprocessing Workbook).

Major Word of Caution- An upgrade to this program was released in early 2012 (Version 6.0). This version DOES NOT read in the depth data from the Garmin, thus if you download your trackfile with version 6 and then erase the memory on your GPS you will LOSE YOUR DEPTH DATA!, and yes, we found this out the hard way. We have reported the problem, but a quick scan of the known issues and bug fixes does not list this problem as addressed. You must use an older version, such as 5.04.001 to successfully retrieve the depth data in a trackfile. This older version of the program can still be found online via secondary providers, or can be requested from the creators.

Garmin GPSMap to ArcGIS Trackpoint Transfer

We use the free Minnesota DNRGarmin program **version 5.04.001** to download tracks and save as .txt file that can be added as XY data in an Arc project



Transferring images

Image transfer is as easy as can be. Insert the SD card into a desktop computer and copy the contents of the SNAPSHOT folder (or a subset of the contents representing only the survey images of interest) to a folder in the project directory for raw sonar images.

The geoprocessing workbook describes our preferred method for organization of survey data using a structured, hierarchical directory for each sonar mapping project. In order to successfully use the custom sonar tools created by Thom Litts for image processing, elements of your project directory must exactly match the directory structure we describe in the workbook. Thus, it's a good idea at this point to begin reading the introductory sections of this workbook in preparation for the next session.

This concludes Session II- Part B, The Sonar Mission. We're now ready to turn our attention to processing all of the raw sonar data we have transferred to our work computer into beautiful sonar image map layers.

Sonar Image Transfer

