Acoustics Guidelines

SPLASH

2004 Cetacean Surveys
Southwest Fisheries Science Center

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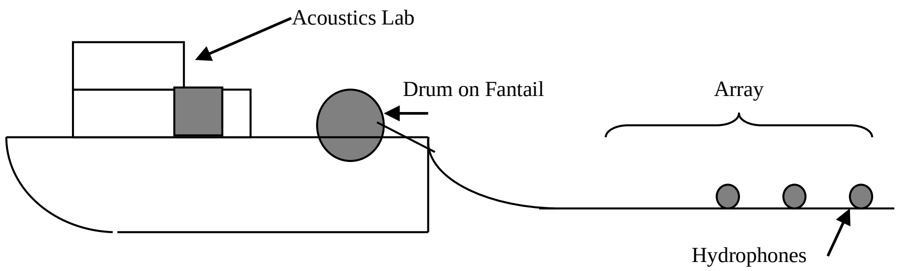

Hydrophone Array *(in water)*

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Hydrophone Array

The “array” is a passive towed hydrophone array. It is passive because it “listens” to sound, but does not make any of its own noise (as opposed to a depth sounder or other active acoustical device). It is towed by the ship (hence the “towed”), and it consists of multiple hydrophones. The entire array has three basic components, the tail (rope or excess cable), the hydrophone elements, and the cable.

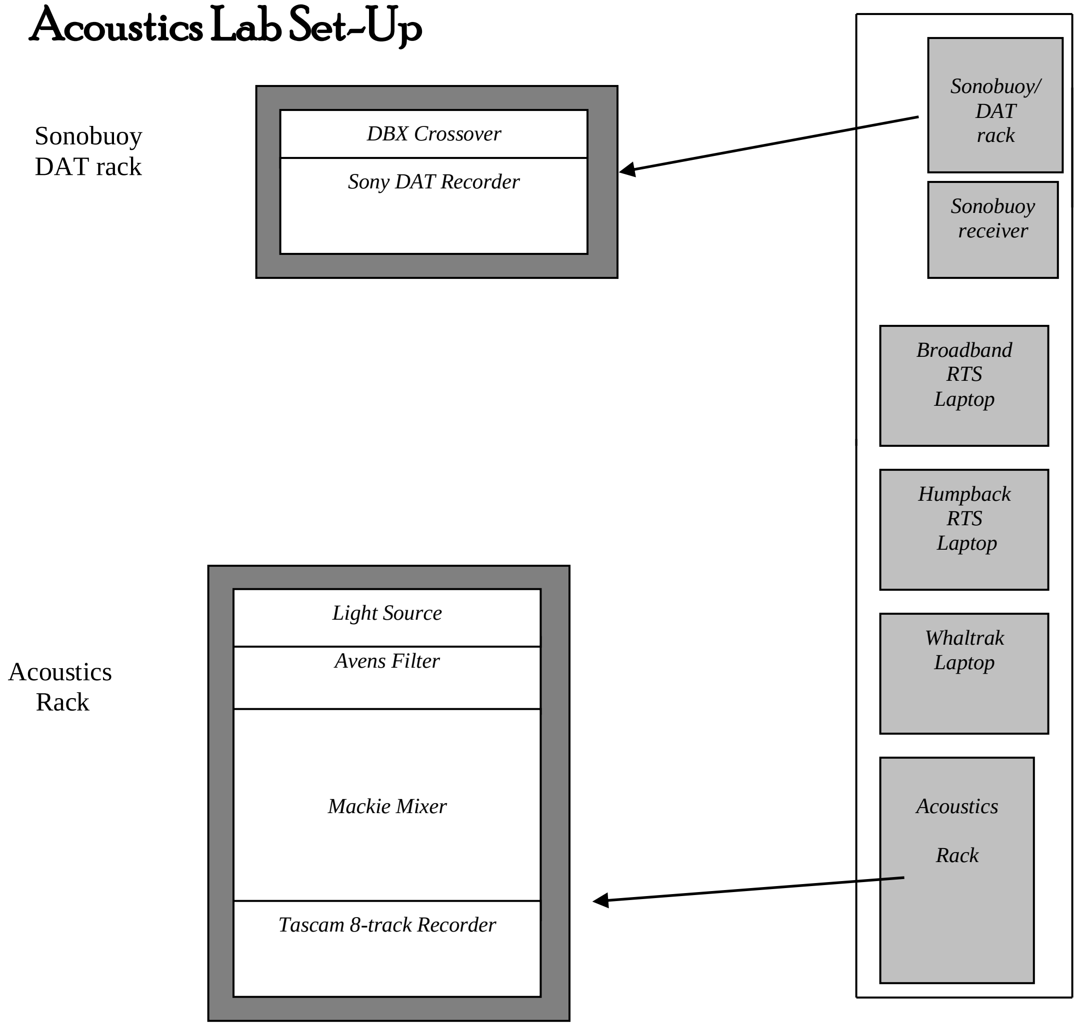
When a long string is towed behind the ship, the back end of the string will flail about, fishtailing in the water. After months of abuse, this would put unnecessary stress on the hydrophones, and so a rope tail is attached to the end so that it can bear the abuse.

The array consists of typically three hydrophone units, with a connector at one or both ends. These elements are relatively delicate, and should not be manipulated unnecessarily, especially under tension. Fifteen to twenty pounds of lead weight (coiled around the cable with duct tape) are attached at the cable end of the array to allow it to sink. With the lead attached, the array sinks to an average depth of 15-18 ft. It is important to have an understanding of how the array responds to the movement of the ship, so that we can avoid running over the array while maneuvering. When the ship slows down, the array will sink (imagine how a water-skier reacts to the speed of the tow boat). If the ship were to stop, the array would (in time) sink so that it hung straight down from the ship. This is not such a good idea, as it could get caught in the props. If there are any circumstances where we might need to slow below 3 knots, then the acousticians should be prepared to bring in the array. Possibly the greatest strain on the array occurs during tight turns at full speed. Due to the strain of bending the array while under tension, the array will also be pulled in whenever tight maneuvering is necessary (ex, biopsy bolt retrieval). Do not attempt to bring in the array while turning unless the ship speed is less than 3 knots (and even then, pull in the hydrophone elements by hand to prevent stress).

The cable itself is divided into two parts, the array and the deck cable. The hydrophone array consists of a length of cable with the hydrophone units molded in. It is wound on a spool or winch for deploying/retrieving. Roughly 300 m of this cable is deployed during normal acoustical operations. At the base of this cable, attached to the winch drum itself, is a connector. This connector forms the joint between the array cable and the deck cable. It is very important that the connection is secure and watertight during operations, and that it is disconnected (and watertight) for retrieval/deployment (and while the array is in). It is crucial that the cables are disconnected before operating the winch. The brake on the winch serves as both a reminder to disconnect the cables, and to prevent the winch from free spooling cable while deployed. Free spooling can (and has) cause breakage to the deck cable, so it is important to remember to lock the winch. The deck cable serves as transport for the electrical signal and power between the hydrophone array and the equipment in the acoustics lab. From here, the cable goes over to the rack, and into the system. The next step is the mixer, then the various recording devices, etc.

Our primary array for the SPLASH cruise will be a homemade 3 element array, and the third element will have a high frequency hydrophone for high frequency dolphin recordings. This hydrophone will be our primary hydrophone for high frequency vocalizations, and will be the hydrophone routed to the broadband ISHMAEL computer, so the spectrum can be altered to view high frequencies, if necessary.

Acoustics Lab Set-Up



Acoustic Rack

There are two mounted racks in the acoustics lab, one for the recording equipment for the hydrophone array, and one for the recording equipment for the sonobuoys. The main acoustic rack, shown in the diagram below, consists of a light source, an Avens Filter, a Mackie Mixer, and a Tascam 8-track recorder. The rack for the sonobuoy equipment contains a Sony 2-channel DAT recorder a DBX Crossover. The wiring diagram (next page) outlines the basic connections between the components. Basically, the signals from the hydrophones are sent along the cable into the acoustics lab, where they go into the first 7 channels of the Mackie Mixer. From the Mackie Mixer the channels go directly to the Tascam Recorder before returning to the second half of the Mackie Mixer. The channels are then split off to the headphones and the Avens Filter before going to the computers for digital signal processing. The wiring for the sonobuoy rack is simple: the signal from the sonobuoy receiver is sent to the rack mounted Sony DAT (and the desktop computer), and this signal is then sent to the DBX crossover for headphone monitoring. All of these components are explained in the general order of their use in the system.

Avens Band Pass Filter

This filter is located at the top of the rack, and is used as a low pass (which is the same as "high cut") and high pass (which is the same as "low cut") filter. This filter is used for hard disk recordings and headphone output.

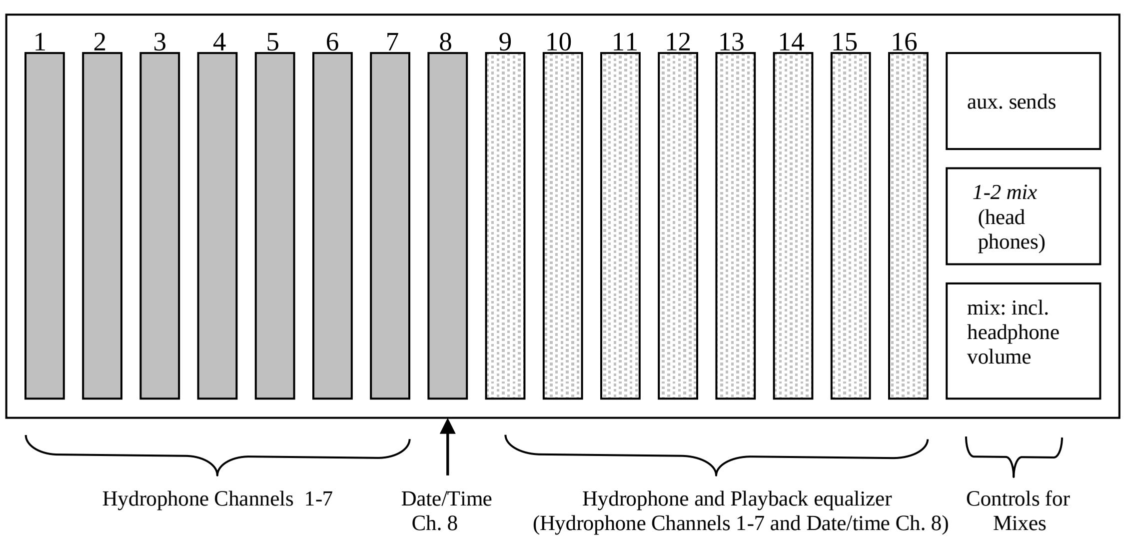
A note about the terms low pass/high cut/ high pass/ low cut. This may at first seem very confusing, but they are simply terms to explain what frequencies are allowed through (pass through) and/or what frequencies are cut. Therefore, a low pass filter allows the lower frequencies to pass, but essentially cuts out the higher frequencies. Therefore the terms "low pass" and "high cut" are used interchangeably in this case. Similarly, a high pass filter allows the high frequency signals to pass while cutting out the lower frequencies, it can be interchangeably called a "high pass" or a "low cut" filter.

There are two sets of dials on the Avens, one for the high pass and one for the low pass. The low cut (or high pass) determines the lower cut-off point for this filter. Typically, we will keep it at 5 Hz (essentially, this is like not having a lower cut). The high cut (or low pass) is typically kept at 75 kHz, so that we can obtain (or pass through) signals up to 75 kHz in frequency.

Mackie Mixer

The Mackie Mixer is the rack-mounted, knob-intensive device, and it is used as an equalizer, filter, volume control, and mixer (to send channels to the various recording equipment). It initially looks very confusing, and it is worthwhile to take a little time to become familiar with some of the basics. The manual for the mixer is good, and the sections below are worth reading:

The input from the array and bow mounted hydrophones goes directly into the Mackie Mixer Mic Inputs, and down the first seven channels. The microphone for the date/time stamp goes into the Channel 8 Mic Input. The left side of the mixer (solid gray) is reserved for the direct signal, and these dials should not be altered, as they will affect all the recordings (consistency is important, and once the ideal parameters are determined, it is important that they are kept the same). Once the signals have gone through the equalizers and the faders on the left hand side (modified by the knobs in the first 8 channel strips), then the signal goes out to the various recording devices (Tascam, DAT, HD recording).



In order to understand how the mixer is used for our purposes, we need to first break it down into its components (as we use them). First, the raw acoustical signals come into the input for our initial channels. Under normal operating conditions, we will be using the 3-hydrophone array (inputs to channels 1-3). In addition, the date/time stamp (red box microphone) will lead into Channel 8. [*Note: Due to wiring constraints in the deck cable, if we attach the second hydrophone array to the end of the 5 element Norris array,, the fifth initial hydrophone will be skipped. The three new high frequency hydrophones will become channels 5, 6, and 7. Channel 8 will remain the date/time stamp*.]

While we will need to do some fiddling with the raw signals before recording them (such as flattening the spectrum to increase the dynamic range), we want to minimize these changes. Similarly, we will want these changes to be consistent throughout the cruise, so it will be important that we do not alter these controls from the settings chosen during Leg 1. This is the primary reason for the left 8 Channel Strips being separate from the right 8 Channel Strips. These left Channel Strips are set for optimum recording conditions and SHOULD NOT BE ALTERED!! They will be occasionally checked to make sure they are in the correct position. Should they be changed, accidentally or otherwise, it is important to make a note in the log of how they were changed, and to return them to their original position. So, the raw signal is put “in” to the first 8 Channel Strips, and then they go out (through the back patch board) to the various recording mechanisms (the Tascam, DAT, HD via Avens).

Again, it is important that the data recorded into the various machines is fixed, and therefore it should come from the left eight Channel Strips. However, there are times (as in most of the time) that we will want to alter the sounds in real time or playback. We want to be able to do this without altering the original sound entering the recording devices. So…. after the sound goes through the initial equalizer settings (the left channel strips), we are going to want access to it to futz around with on a day-to-day basis. We are also going to want to futz around with signals we playback. This is what the second set of Channel Strips are for (Ch. 9-16). In order to allow for both of these goals at once (allow for manipulation of signals in real time and playback), we can re-route signals from the Tascam back into the Mackie Mixer through Channels 9-16. The Tascam receives all eight channels. The sound from Channel Strip 1 (after going through initial equalization) will then go into the Tascam (Ch 1 in the Tascam), then out of the Tascam and into to Channel 9 in the Mackie mixer. The sound from Channel Strip 2 will then go through the Tascam and into the "in" for Channel Strip 10. This continues through Channel 8, which goes "in" to Channel 16. This second set of Channel Strips is independent of the first set, however it is made up of the signals that have gone through the first set of Channel Strips. Even though these signals go through the Tascam, they are (for most purposes) not altered by the Tascam. [*Note: the Tascam does have a filter built into it, and the signals are subjected to a low pass filter, which cuts at about 25 kHz. So, the signals that are recorded by the Tascam, are played by the Tascam, or go through the Tascam, are subjected to this filter. Therefore, all signals that enter Channels 9-16 are cut off above 25 kHz*]. Now, this second strip of Channels (9-16) is the set of strips that we can futz around with (well, to some degree…).

The knobs in the second strip will allow us to make changes to the equalization, which is especially helpful for optimizing our monitoring ability in the headphones, and for pulling out specific sounds in playback. In our daily monitoring we really don't want to mess with these knobs too much, and it is wise to return them to how they were when you are done. The top button, the "trim" is essentially an input volume, and we should not need to alter this one much. The second set of knobs, the "auxiliary" knobs (the next lower 4 knobs) also should not be messed with. The next set of knobs are the "equalizer" knobs (EQ), and these are the knobs we might want to mess with for headphone optimization and playback. I suggest first reading the manual to understand how the changes will affect the signal, and then take a few minutes to play with them to see how it changes the sound (but remember to return it to it's original spot). If the low frequency ship noise becomes overwhelming at any point, there is a low cut button that will sharply cut off any frequency below 75 Hz (although the ship noise that truly interferes with our ability to hear other sounds is at higher frequencies, up to 500 Hz). The bottom set of buttons has to do with the mixing of the channels, which is explained next.

Ok, so we have all these channels and we can play with them at will (well, to some degree). The mixer also has a feature of creating “mixes”, which are groups of channels that can be easily changed and re-routed for various purposes. There are three sets of mixes (each consisting of two channels) that we can set up. They are the “1-2 mix”, the “3-4 mix” and the “L-R (Left-Right) mix”. In the back patch panel there are “outs” for these different sets of mixes. On the front panel are sets of buttons for each Channel, one for the “1-2 mix”, one for the “3-4 mix”, and one for the “L-R mix”. One of the goals is to minimize the need to rework the wiring in the back of the rack (this is a pain and things can easily be wired incorrectly). So, the idea is that you decide that, say, the Hard Disk recordings will come from the “L-R mix”. In the back, the “out” for the “L-R mix” would be connected to the computer. We aren’t going to want to change that, but we might want to change the actual channels that go into the computer (sometimes certain hydrophones get better reception than others, for example). Instead of changing the patch in the back, we can simply choose different channels for the “L-R mix”.

To choose a mix, you first decide what two channels you would like. For example, for the Hard Disk recordings we DEFINITELY want to record from the high frequency hydrophone (Ch 3), and we would also choose a secondary channel (although we would keep it “dialed” into the CH 3 under normal conditions). So, for example, we might choose CH 1 for the “right” and CH 3 for the “left”, and we will choose these from the left-hand side (channel strips 1-8), as they have gone through the equalization but have not had high frequency cutoff due to the Tascam. Since the computer is hooked up to the L-R out (in the back), we simply push in the button on the front bottom of the Channel Strip 1 and Channel Strip 2 that corresponds with the L-R mix (you can look at it from the side a little to see if it is depressed). The next thing we need to do is determine which channel will be Left, and which will be Right. This is done using the PAN knob (the bottom of the knobs, between the equalization knobs and the mix buttons on the Channel Strip). You can Pan Left or Pan Right (but make sure that one channel is left and one is right!). Do one at a time and check on the computer monitor to see which panel lights up; make sure that you know which channel is for the left and which is for the right. Any time you make a change to the mixes, especially for the recording devices, make a note of this in the Log. In general, these changes should not be made unless absolutely necessary. For our purposes, we will only be recording from one channel for the hard disk recordings, and this will be the "left" of the left/right mix, which should be the high frequency hydrophone (CH 3).

Now that we have determined the L-R mix, we still have two other mixes available to us, the 1-2 mix and the 3-4 mix. For our setup, the 1-2 mix is for the headphones and the 3-4 mix is for detecting sperm whales with Rainbow Click. We won't want to change the 3-4 mix for Rainbow Click unless we change the hydrophone array. For the headphones, we can change them according to our needs, and we will likely want to filter out ship noise so we can better hear dolphin whistles. This is a perfect opportunity to use the second set of Channel Strips, where we can filter the sound without altering the sound that is being recorded. So, our 1-2 mix select will ideally be from two of the Channel Strips 9-16. Remember that under normal conditions Ch 8 is the date/time stamp and Ch 4 - 7 are not in use. So, we will want to choose two of the Channels 9-11 for our 1-2 mix. Depending on how good the channels are, you may want to switch them on occasion. For our general purposes, however, we will simply choose Ch 1 and Ch 3 (the hydrophone array elements). Remember that these must be Panned, one for the left (1 of the 1-2 mix) and one for the right (2 of the 1-2 mix). Now we can cut away low frequency noise and boost higher frequencies for optimum monitoring without altering the sound we will be recording.

Since the eight channels are run through the Tascam before entering the second set of Channel Strips, if you playback a tape in the Tascam, you can equalize it and filter it through these second set of Channel Strips for optimization of the playback signal. For example, if you have recorded baleen whales, which are typically low frequency signals, you may want to filter out most of the sounds above 2 kHz.

So, we've got our raw "in's", from the array that feed into Channel Strips 1-8. We do some simple manipulation of the signal and send it out again to the recording devices (directly, in the case of the Tascam, or indirectly in the form of mixes in the case of the hard disk recordings). The sound is then re-routed from the Tascam (where it is unchanged except for a low pass filter at 25 kHz) and back into the mixer in Channel Strips 9-16. These strips are used for the headphones (the 1-2 mix) and for playback (all channels).

Ishmael is a real time spectrograph (RTS) program with beamforming capabilities that is run on the newer Toshiba laptop computers. The feed for the signal into this computer comes from the second half of the Channel Strips, so this display will be affected by tweaking of the equalizing filters of Channel Strips 9-16. [The out on the rack side is through the auxiliary sends, through the back patch board of the mixer. There should be no need to change this throughout the cruise]. The desktop computer runs the high frequency hard disk (HD) recordings and the SpectraPlus RTS display, and runs off of one channel only. Because the HD recordings require that the very high frequency signals remain intact, this line cannot go through the Tascam (remember, the Tascam has a built in low pass filter). Therefore, this line must come out of the mixer after having gone through the initial processing from Channel Strip 1, but before being sent to the Tascam. As mentioned above, we can use one of the "mixes" (L/R, etc) on the Mackie Mixer. We still want the capabilities to filter this signal, and we do so through the Avens filter. From the Left "out", the signal is then routed up to the "in" on the Avens filter (and out to the laptop computer). For more information on this, see the information on the Avens Filter.

Tascam

The Tascam is a multi-channel recording device that records from eight different channels onto Hi8 tapes. There is a manual on the Tascam in the main shelving, I suggest reading the following sections:

The Tascam will be used primarily for dolphin and sperm whale recordings; the ability to record several channels is beneficial for running the beamforming programs such as Ishmael. A total of 7 independent channel inputs can accept up to 7 hydrophone elements. The three array hydrophones will typically appear on channels 1-3 on the Tascam, the lab microphone appearing on channel 8. Different hydrophone arrays will appear on different channels (depending on the wiring configuration), so keep this in mind if we change hydrophone arrays. For normal operations, channels 4 - 7 do not carry signals. Channel 8 is used for a date/time stamp, using the little red box velcro'd to the rack.

Most of the settings on the Tascam are set, and do not need to be fiddled with. The important things that you will need to know how to do are to record, playback, and format tapes. When you start during the day, the Tascam will most likely have a blank formatted tape in it (tapes will be formatted at night). Remove this tape (be sure it has a blank white label on it), and put it away. Replace the previous day's tape (it should be labeled with the tape number). Check the time on the tape with that in the log to make sure that this is the proper end time of the last recording (we want to make sure that we don't record over anything accidentally). Also check the channel bars (far right): if sound is coming through under normal circumstances, you should see the signal in channels one through five and eight. Tap on the microphone to confirm that you are getting a signal (taps show up as lights on the Tascam). The Tascam is ready for recording.

When signals are heard and you wish to make a Tascam recording (for dolphin whistles and sperm whale clicks), you simply hit the record/play buttons, and make sure to note the start time. This should be recorded into Whaltrak (BRTx yy.yy.yy), where x is the Tascam tape number and the y's are for the time the tape was started at. In the log, note this information as well, in addition to the local time and some basics about the sighting number and species. Be sure and hit the buttons for the date and time stamp (one at a time); this will be recorded onto channel 8.

For beamforming and plotting purposes, we want a continuous recording of the entire acoustic encounter (from the first faint dolphin whistle to the last). There are often silent gaps in vocalizations, but you will want to continue recording until you are as sure as you can be that you are not detecting that group any longer. If the signals stop, note a good time to rewind to if the signals do not return. You can then continue to record, just in case. For example, I am recording dolphin whistles, and at 1:28:03 I realize I haven't heard any for several minutes. I will make a note in the log that this might be a good spot to go to if I don't hear any additional signals. If I hear another bout later, I will want to change this potential rewind time to later, after I haven't heard any signals for a while. Then continue recording until you are sure the animals are long gone, and you can rewind to that spot and record over the 'silent' area.

If we want to playback a signal or tape, we rewind to that area and hit play. You will need to "uncheck" the 8 buttons for the record function on the Tascam (bottom right of Tascam). The sound will be automatically routed through the second set on the mixer (channels 9 through 18), the computers, and to the headphones. See the information on the mixer to check how to mess with the signals. Be sure when you are finished to reset the tape and recheck the rec. function buttons so that it is prepped to record.

Sonobuoys

Sonobuoys are disposable hydrophone units, and we manage to scrounge up a few from Navy surplus to be used in certain situations. Since the sonobuoys are disposable, we can deploy them near a sighting and then leave the area, so that the recordings are less likely to be masked by ship noise. This is especially important with lower frequency vocalizations, such as those from baleen whales. They are also free, that's a good thing. However, the surplus buoys are usually past their prime, and there is a high failure rate, usually due to dead batteries (which are housed within the sonobuoy unit).

The sonobuoy itself consists of a metal housing, often within a plastic case. Within this housing are a battery, the hydrophone, a float, and an antenna. When you prep the hydrophone, you want to take it out of the plastic case and cut off any excess garbage (to minimize disposal of plastics in the ocean). You will then need to set the depth, the transmission time, and the transmission frequency.

When the sonobuoy is deployed, the antennae float pops up. The antennae transmits the signals obtained by the hydrophone (which sinks to a specified depth upon deployment). These transmitted signals are received by the ships antennae and transferred to the acoustics lab by a cable. When choosing a transmitting frequency, there are several factors to take into consideration. First, there are many channels that cannot be used in the EEZ (Exclusive Economic Zone- within two hundred miles) of any country. Chances are that if you are in the EEZ you cannot toss a high frequency sonobuoy on a sighting. The Jordan's antenna's are a little better at receiving frequencies between 156-158 MHz (which correspond to channels 86-91). We would therefore receive signals from these channels for a longer duration than we might receive from other channels. Another factor to take into consideration is if other buoys were tossed nearby. You want to make sure that you receive from a "clean" frequency, with minimal interference. Therefore, if you will be using two sonobuoys in a sighting, or on sightings near each other (w/in 10 nm or so), then you will want to choose transmitting frequencies that differ by at least 2 channels.

After you choose a frequency, set the sonobuoy to that frequency by pushing the buttons until that number is set (some sonobuoys have a fixed frequency and cannot be changed). You will also want to choose the depth of deployment, and that will depend primarily on sea state. Ideally, you would like the sonobuoy as near the source (whale/dolphins) as possible, and this is usually in the surface waters. If it is a deep diving animal, you may want to set it deeper. If the sea state is poor, then noise from breaking waves could interfere with our recordings, so it can be set to a deeper depth to avoid wave noise.

In the lab, make sure the receivers are on, and set to the appropriate channels. Make sure the DAT is set up to record (see section on the DBX and Sony Dat). Take a radio with you to the fantail to toss the sonobuoy, and ask the flying bridge to inform you of a good time to toss the buoy. Then ask the bridge for permission to toss the buoy. Toss in the buoy and ask the flying bridge to make a note in WinCruz. Watch the sonobuoy until the antennae pops up. If there is a good signal, let the flying bridge know and monitor the sonobuoy. If there is no signal and you suspect that it was a bad sonobuoy, prepare to toss another (and let the flying bridge and bridge know your intentions).

Once you have a good signal, make a red dot on Whaltrak noting where the sonobuoy was deployed, and comments regarding the sonobuoy and sighting. You should continue recording until the receivers are no longer receiving a decent signal. At intervals, write down in the log how many bars each channel are consistently receiving. Be sure and fill out the information (including the lat/long) in the front of the sonobuoy green book. It is also helpful to write down the heading of the ship as we leave the buoy. Any additional information from the observers regarding the animal's location, behavior, or other species/animals in the area are also helpful. Remember that the person analyzing these data will have no idea of the situation in which the recordings were made, so any information is helpful!!

DBX Crossover and Sony DAT Recorder

The DBX Crossover acts as an equalizer/filter by first splitting the sound into relative sound ranges (low, mid, and high frequencies), and then allowing for manipulation of the intensity of any given range. This is especially helpful for aural detection of low frequency baleen whale vocalizations.

Above the crossover you will see a low-, mid-, and high-frequency board. This is connected to the back patch board of the crossover and can be used as a headphone output. The first thing you must do is decide what kind of signal you are working with. If you are examining baleen whale vocalizations, for example, you might want to amplify the lower frequencies and cut out the higher frequencies (your “noise” in this case). Plug in the headphones to the “low” output above the crossover. Now, you need to *choose* what your low is: this is the crossover point. On the crossover, the first knob on the left is your input intensity knob; pick an appropriate level for the signal intensity input. The second knob will help us define our “low-mid” range. If you are looking at signals below 500 Hz, you would want to choose this as your low to mid cut, or maybe a little higher than this for extra range. The highest cutoff between low and mid is 960 Hz. This is especially helpful for amplifying baleen whale vocals while filtering out the difar signal.

If you are monitoring mid-range vocalizations such as humpback whales, you may want to eliminate the difar signal (high-frequency) as well as ship noise (low frequency). For this range, you would choose your mid-low cutoff at maybe 100 Hz to minimize ship noise and your mid-high cutoff at maybe 2 kHz to eliminate the difar signal. This mid-range between 100 Hz and 2 kHz can be amplified and monitored via the mid-frequency headphone jack. Similarly, if you were listening to high frequency dolphin whistles, you would choose the “high” plug and choose a cutoff point at which you would not want to hear signals below (say, 5 kHz).

You will want to do this procedure for both channels (this is stereo, so there is a left and right), and then you can change the output intensity with the associated knob.

Computer Programs

After the received sounds from the hydrophone are passed through the various acoustic equipment in the rack, they will be monitored aurally through the headphones and visually through the use of computer programs. We will be using 3-4 computers, simultaneously at times, in order to monitor, beamform, and create hard disk recordings of vocalizations, in addition to collection of basic data and notes.

There will be three primary computers: two laptops are dedicated to running the real time spectrograph program (Ishmael), and one to running the mapping/logging program (Whaltrak). The two Ishmael computers will show different frequency bandwidths: one will be for low frequency (below 1 kHz) to focus on humpback whales, and the other for the normal full bandwidth (up to 20 kHz). All primary computers will be running while the array is in the water. One of these Ishmael RTS computers will also be setup for making high frequency hard disk recordings (using Ishmael) and the other will be setup to view sonobuoy recordings. There will be extra backup computers in case things get too busy!

Whaltrak

Whaltrak is both a mapping program and a data entry program in one. The Whaltrak computer is connected to a GPS feed which will give lat/long in addition to a date/time stamp for each entry. It is also set up to map and log bearing angles received from Ishmael (via a 9 pin serial port connection).

To turn on Whaltrak, double-click on the Whaltrak icon on the desktop. For the program to operate correctly, it should be receiving the GPS feed (there will be an error message if it is not working properly). Click the effort box once to change to “On Effort” status (this effort status is for the acousticians, and should be on whenever we are monitoring the array- regardless of the status of the visual team). At the beginning of your shift you should enter in your initials as the operator (do this by single-clicking in the box to the left of the word “Operator”, and then type in your initials). First thing in the morning we will need to make sure we start the timer on the watch for the 5-minute updates.

The five-minute updates are a simple summary of the sounds heard during the previous five minutes. The updates are timed on the small watch and should continue anytime the acoustician is on-effort. It is important that these updates occur every five minutes, on the five minutes (for example, 9:00, 9:05, 9:10, etc). This data may be collated with behavioral information, and it is therefore important that all updates are in sync. Each individual update code should be independent; for example, information about dolphin whistles (DW12) should be a separate comment from EC for echolocation clicks or BP for burst pulses or PM for sperm whales (see the example Whaltrak file at the back of this manual). If there have been no signals during the previous 5 minutes, then an “NS” should be entered in the comment line. Reserve these codes for the updates (only), as they will be located using a computer search. If you wish to enter in a comment that there were echolocation clicks, write “loud ec” or “ec heard” or “ec!” rather than the plain “EC” reserved for the five-minute updates. If an unknown sound is heard, then an “OT” for “other” can be entered, but it should be followed by a comment or description of the “other” sound.

We will also want to enter in information regarding visual sightings (the sighting number, original angle and reticle, species i.d., and if vocals were detected). The observers may also call down updates or behavioral information, such as school cohesion (“tight” school, or “spread out”) or abrupt changes in behavior. We will also enter in information provided on bird flocks (please note if it appears to be associated with any vocalizations!). We will often hear dolphin schools (or sperm whales) that are not seen by the visual observers (“non-sighted” or “NS” groups, see explanation under data collection). We will want to enter in notes regarding first whistles detected on a new group, when the group passes the beam (and the distance), and when we no longer detect the group. If the groups are not detected by the visual team, we will assign them an “NS” number, and this should be noted in Whaltrak, as well as the overall (or greatest) acoustic detection distance. We can always edit out unnecessary comments later, so it is better to put in many notes as opposed to few.

The “AQ” (array quiet) and “AN” (array noisy) should be used when there is a change in the noise level of the array. In the beginning of the day, an “AQ” (if appropriate) can be entered, and then if this status changes, then an “AN” would be entered. Typically, array noise varies by the speed and turning of the ship, however other factors may cause this, such as problems with a hydrophone or the cable. *The AN should be noted when it appears that vocalizations will be missed due to this noise*; if there is a moderate increase in noise due to rain, for example, then simply make a note of this in Whaltrak, limiting the AN notation for extremely noisy circumstances.

We will also enter in comments when we begin a Tascam or hard disk recording. For Tascam recordings, type “BRTx yy.yy.yy” where “x” is the tape number and “yy.yy.yy” is the time on the tape. For example, “BRT1 1.02.00” is for “**B**egin **R**ecording **T**ascam tape **1** at Tascam time **1:02:00**”. If you do not have the TASCAM time immediately available, you can enter the “BRT” immediately, and then enter the correct time as a comment a few seconds later. It is important to have the beginning noted immediately, so that the correct time is available in the Whaltrak record. Also, we must not forget to put in a comment for when we *end* a recording on a tape! It will be the same, except with an “ERT” for “End Recording Tascam”. If we begin a hard disk recording, simply enter in “BRHD” for “Begin Recording Hard Disk”.

Often when we are on chase, or in regions with a lot of squalls, we may divert from our course a lot. When the observers call the bridge for a course change (or vice-versa), we click on the “turn” box, and then (separately) enter in a comment stating the purpose for the change of course. If we are turning a lot while on chase, you do not have to comment on all turns. By hitting the “turn” button, the computer then calculates the course more often using the GPS feed, and therefore the course plotted in Whaltrak is more accurate. Sometimes it is really helpful to put in information about the turns (ex, 50L means turning 50 left). If you are too busy, don’t bother… but if you are just sitting there, it is helpful.

At the end of the day, we turn the effort “off”, and then exit the program by clicking on the colored “X” button on the top right corner of the blue-green screen. This will safely exit the program, so that all the last information is saved. When closing Whaltrak at the end of the evening, the closing acoustician should save the day’s Whaltrak file(s) to the “Whaltrak” floppy disk and then move the files to the “new” folder (C:\Whaltrak\New folder). The Whaltrak floppy is used as a transfer disk and raw data backup. These files can be opened in WordPad (uncheck the “always open as” button) on the email computer. Print out and staple the compiled Whaltrak file for the day (if Whaltrak is closed and reopened during a day, there will be a separate file for each).

It will be the primary acoustician’s responsibility to edit the data. This edited data will be saved to the “edited” folder in the Whaltrak folder in the c: drive. The edited data should be saved as an MS-Dos text file, using the name TrakALL.xxx, where xxx is the month/day notation for the file. During the editing process, it is important to make sure that all recordings (on all types of media) are noted in Whaltrak. The green book and the Whaltrak files should be cross-checked for accuracy. Additionally, it is important that all sighting information (including “NS” sightings), especially sighting number and species, are entered in for each sighting.

Whaltrak Codes

Sounds Heard

DW	dolphin whistle
EC	echolocation
BP	burst pulse
PM	sperm whale
BW	baleen whale
OT	other
NS	no sound

Rate of Occurrence

1	one or two
2	several
3	sporadic bursts
4	constant
5	constant and overlapping

Loudness

1	barely heard
2	faint
3	clear
4	loud and clear

Recordings

BRHD	begin recording to hard disk
ERHD	end recording to hard disk
BRTxx	begin recording to Tascam tape# (then time begin yy.yy.yy)
ERTxx	end recording to Tascam tape# (then time ended yy.yy.yy)

Other Common Abbreviations for Lazy Acousticians

AN	array noisy
AQ	array quiet
ID	final species ID
HS	half speed
FS	full speed
CS	course and speed
UW	unidentified whale
UD	unidentified dolphin
BOT	beginning of tape
EOT	end of tape
BF	beamform
Obs.	observers
HP	hydrophone
nmi	nautical mile
ret	reticles
NS	non-sighted (dolphin school)

Ishmael

Ishmael is a digital signal processing program that has real time beamforming capabilities. Given an input signal across two or more hydrophone elements, the program is able to determine the angle of the sound source from the ship. These angles can be plotted to Whaltrak. The point of convergence of successive angles can allow for the location of the source (with a left/right ambiguity). This is helpful that visual and acoustic detections are the same animals. It also allows us to determine the location of vocalizing animals that were not detected by the visual team.

To open Ishmael:

- Double-click on the Ishmael shortcut on the desktop
- Under Data Translation, click on Configure DT board
- When this window opens, click "ok" (or enter)
- When the screen opens (into three channels), go under View and click on "only 1 Channel"

There are two types of location algorithms used by Ishmael: phone-pair bearing and beamform bearing. While these are two different methods, we typically use the term "beamforming" to refer to either method. The phone-pair method determines the angle of the sound source by measuring the time delay between two hydrophones of known spacing. The phone-pair bearing will present a cross-correlation plot; a high peak is associated with a strong correlation between the hydrophones, indicating a good bearing angle. Ideally, we want to avoid using angles that have little or no peak. This method is ideal for short duration vocalizations such as sperm whale clicks and dolphin echolocation clicks, as well as whistles with a significant change in frequency.

To BeamForm using Phone-Pair Bearings:

- When a good call is heard, click on the screen to pause Ishmael (or hit space bar)
- Use the cursor to select (box) a section of the vocalization that has good signal to noise ratio
- Under the Localize menu, click on "Phone-Pair Bearing", or click on the Phone-pair bearing shortcut
- To plot the last angle, click on the "Send to Whaltrak" (last) shortcut button
- When you are finished beamforming the vocalization on the screen, hit the "Run" shortcut button to resume the real time spectrogram in Ishmael

The beamforming algorithm uses frequency characteristics of dolphin whistles to determine the angle of the vocalization from the array. The basic contour of the whistle is outlined and then run through the beamforming algorithm. This takes a few seconds to compute, and this does not appear to be as consistently accurate as the phone-pair bearing. As this method uses frequency characteristics, it is not as accurate on tonal or unmodulated whistles.

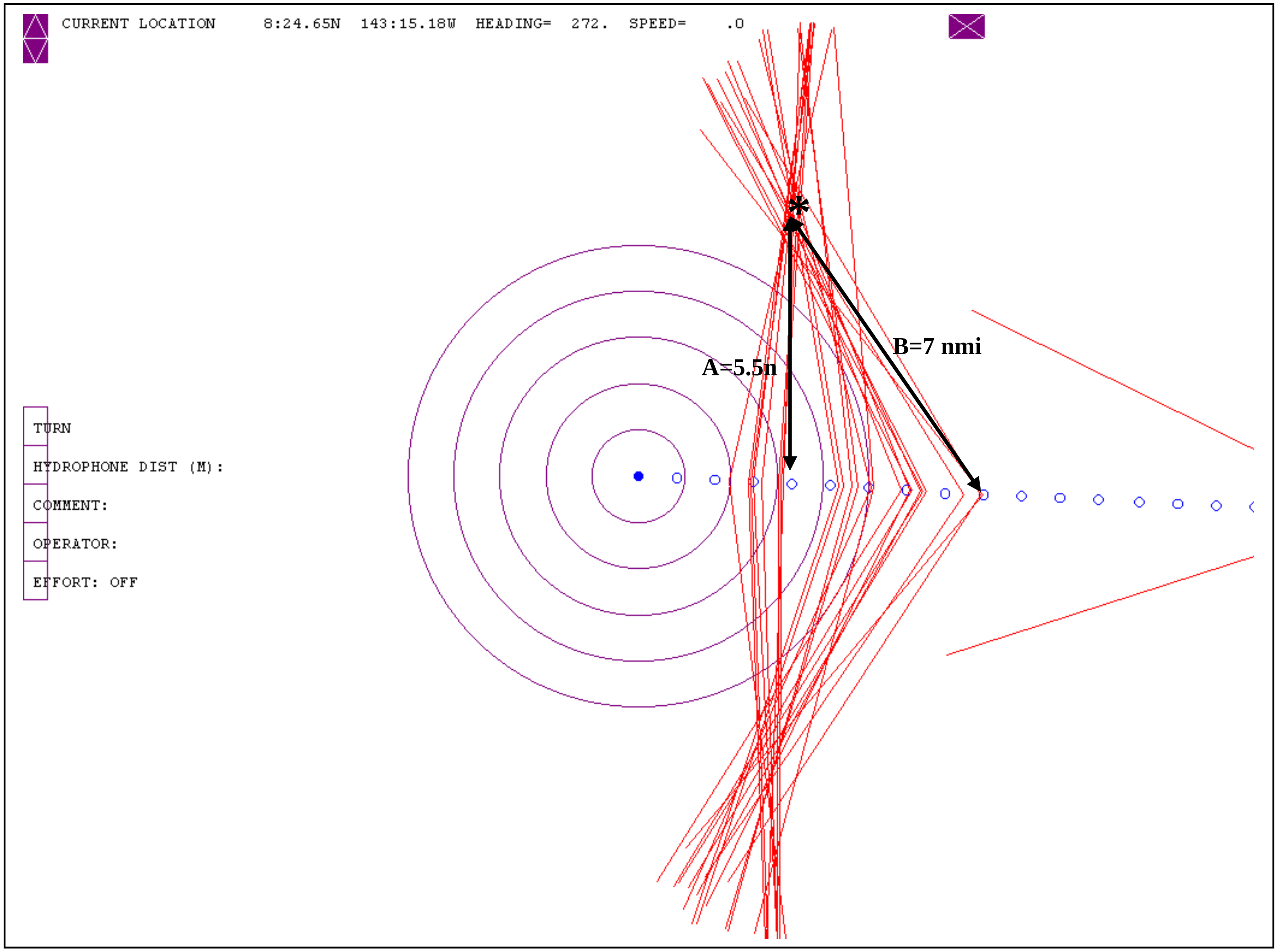
To Beamform using Dolphin Whistle Contours:

When a good whistle is seen, click on the screen to pause it
To contour the whistle, we hold down the control key while clicking the mouse on end points and inflection points of the whistle (maximizing the signal to noise ratio)
Under Localize, click on “Beamforming bearing” or click on the Beamforming shortcut button
To send the last bearing angle to Whaltrak, click on the “Send to Whaltrak” (last) shortcut button
When you are finished beamforming the vocalization on the screen, hit the “Run” shortcut button to resume the real time spectrogram in Ishmael

We can also use Ishmael to save acoustic recordings directly to the hard disk. We want to make hard disk recordings of good vocalizations of all the single species dolphin schools, however we also have to keep in mind that hard disk space is somewhat limited. A five-minute recording session is sufficient for most dolphin schools. If there are many vocalizations that are high frequency, and for species such as Risso’s dolphins and killer whales, we can record for the entire time vocalizations are heard.

To Make Hard Disk Recordings on Ishmael:

When good vocalizations (but not overloading!) are seen, stop the display
Under Record, click on “record sound”
The directory, file names, and length of recordings should be preset, so click on “Enable Recording”, the “OK”
Click on “RUN”… Continuous recordings will be made while the spectrogram display is running.
When you have enough recordings, repeat the process by un-selecting “Enable Recording”
If you are unsure if the computer is currently recording, while the spectrogram is running you can click on the “record” menu and see if there is a check next to “record sound”.



Ishmael beamform angles plotted on Whaltrak. Whaltrak plot of beamform angles with approximated (a) closest distance of approach and (b) greatest distance for a non-sighted sperm whale detection. The ship position is indicated by small open blue circles; final position is shown as a closed blue circle with one nautical mile concentric circles as a reference for distance. The "*" indicates the position of the dolphin school as determined from the convergent beamform angles. The closest distance of approach for groups passed in passing mode was typically the distance of the group as it passed the beam of the ship or hydrophone array.

MS-Dos Record

MS-DOS Record is a DOS-based program for making recordings that are saved to the hard disk in an uncompressed format. We will use ISHMAEL as our primary recording program, as it saves continuously in predetermined bins (ex, one minute bins). We will use the Record program as a backup if we are having problems with Ishmael.

When we are in a school of dolphins (or small whales like beaked whales, pilot whales, etc), and we are receiving good signals (whistles, echolocation clicks, or burst pulses), we will want to record a few samples onto the Hard Drive (HD) of the desktop computer. These signals will be used to examine the high frequency components of vocalizations.

The HD recordings use an extremely high sampling rate, and therefore use a lot of memory on the HD. We will want to make multiple short recordings (approximately one minute) when it appears that we will get useful information. Additionally, if the vocalizations or echolocation clicks appear to be going higher than 20 kHz, then we will want to make a HD recording. Also, if it appears that the animals are directly on the array (observers tell you or if the signals are very intense) you might want to make a HD recording.   These recordings will later be saved to CD to be examined at a later date.

To make a HD recordings, stop close all programs on the computer (if it is running) and double-click on the MS-Dos Record 8X shortcut on the desktop. Recording will begin immediately, and the file name is stated in the first few lines of the output (in the format ACSTxxxx.yyy, where xxxx is the time and yyy is the date). The file name should be entered into the Whaltrak record. Also, write down the sampling rate and the FFT size used. To end the recording, hit Control-Break. If for some reason you want to delete the recording, at the c:\ prompt type “DEL ACSTxxxx.yyy” for that particular file name. If you want/need to make another HD recording, type in “RECORD” at the c:\ prompt.

These recordings will be written to CD as time allows, and these files should be examined using SpectraPlus before being deleted off of the hard drive. See "Writing HD recordings to CD" for more information.

There might be times where you will need to change the sampling rate for recording to the hard drive. When you are in the c: prompt in MS-Dos, type

C: edit record.dat

This will allow you to edit the sampling rate for recording to the hard disk. The first line is the sampling rate; change this as necessary. If you change the sampling rate, you will also need to change the low pass value for the DOS program (to ½ of the sampling rate). Be sure and also change the low pass on the Avens filter as well.

Another feature of this Dos Record program is the View window, a color real time spectrograph. At the c: prompt, type:

C: View

You must then choose the sampling rate and the FFT size (usually use 1024). The View window will now begin scrolling in color. If you need to change the color saturation, you hit the up or down key to do so.

Difar Processing

The Difar sonobuoys are low frequency sonobuoys that emit two high frequency signals used to locate a bearing (in relation to a magnetic compass) of signals detected by the sonobuoy. These two signals are at 7 kHz and 15 kHz. If two difar buoys are deployed, it is possible to determine the absolute location of an animal(s) vocalizing, and to determine their direction of travel, etc. Even with one difar sonobuoy, you can identify signals from more than one animal if they have different bearings relative to the deployed sonobuoy.

There are several steps that must be taken in order to obtain this information, but luckily now Ishmael will do most of these steps automatically. I'll explain the short version first, then the long version (just in case Ishmael poops out on ya).

Quick-and-Dirty-Ishmael-Shortcut: Ishmael should be setup such that the matlab program for the difar processing is input into the matlab functions. Assuming that this is setup correctly (it should be!), then all you have to do is run this matlab function on the signal. If you are running the real time spectrogram function of Ishmael, then simply stop the display, "select" the signal with the mouse, go to "COMPUTE" in the menu display, and at the bottom select "Do MatLab Command". It will take it a minute to compute, but then the display should be given. If you are running the spectrogram function in another program (or if it is a saved file), then simply save the sound, and then open it in Ishmael, then select the sound and have to do the matlab command on the selection. Easy as Pie.

Long-and-Drawn-Out-Old-Fashioned-DIFAR-Processing:
First, the signal is examined in SpectraPlus RTS until the signal is found. You can then copy/paste the signal (use the arrow key to give the cursor selection capabilities, then select the signal, with about 1.5-2.0 seconds lead time, then go to edit: copy, then open another SpectraPlus window and edit: paste function). You can then hit the "run" button to run this spectrogram clip. Now you must export this (file: export) and save it as a binary 16-bit file. Keep this spectrograph open on the desktop.

You now need to save the file as “data.16” in the difar folder. This data.16 file is a file used by the difar program for 16-bit binary files. Once you are all done, you will need to re-save this file under its own name so you can use the name “data.16” to analyze future files.

Once this is saved, open the Run.bat program in the difar folder (where you saved the data.16 file). You use this program to check the difar signal, and to make sure that it was able to ‘lock on’ to signals in this sound segment. It usually takes about 1.5 seconds for the signal to lock on (that is why you need the 1.5 second lead time in selecting the signal). Check the time to make sure all is well.

Now, you must determine the time segment to analyze through the Matlab program “difar”. Use the crosshairs on the cursor in SpectraPlus to determine the start/end time of the signal. Basically, you need a start time (say, 2.2 seconds into the clip), and the length of the signal you want to examine (say, 1.5 seconds long).

Go into the Matlab Edit/Debugger (c:\difar.df.m??) and change the start time and the length of the clip you want to analyze with the difar. In this example your start time would be 2.2 sec (into the clip), and the length would be 1.5 seconds (length of the vocalization). Once these times are changed, save this setting.

Now, go into Matlab and enter “df” to run the difar program developed in matlab. If you are not in the correct directory, type "cd". To go up a directory, then type "cd.." to go up one more directory, then you can type in “df” to run difar. Then hit “enter”. In a minute or so, the visual display will show a colorband display with frequency on the y-axis and bearing on the x-axis. You now must look to the frequency range of the signal you were examining, and find a “cluster” of points at that frequency. This cluster should be associated with the signal selected. You might find a wide band of “noise” at a particular angle, with the noise going across a wide range of frequencies. Chances are that this is the ship noise, and therefore this angle would give you the bearing of the ship (according to a magnetic compass).

Data Collection

The data collection for the acoustics program may seem tedious at first, and once you have the swing of things… well, it still remains tedious (sorry). We are working this data from several angles, and we want to leave options open for other analysis, so we are trying to cover our "assets". It is difficult at first to understand why we seem to be doing double-duty on some data entry, and why we enter in updates every five minutes when we haven't heard anything in two days. So, in addition to explaining *what* to write, I'll also explain a little about *why*. Maybe then the annoyance of data collection will be easier to take.

Data collection falls into two categories: making recordings and making notes. Recordings should be made of all acoustic detections: once you hear a vocalization, start recording. Typically, we will continue recording continuously throughout the sighting until you are confident that you are no longer hearing vocalizations from that group.

Notes will be entered into two places, the whaltrak program and the greenbook log. The primary difference between the two is the accessibility of the greenbook and the gps stamp of the Whaltrak program. We will want most information to be entered into the Whaltrak program, but there is information that is important to have access to as you go through the sightings. We will want this information down in the greenbook, primarily for our own reference. The two will be cross-checked for accuracy daily.

Whaltrak

Whaltrak is our plotting and data entry program that receives a GPS stamp with time/data/location for all entries (see blurb on Whaltrak under "computer programs"). The comments line in the bottom left portion of the screen is used to make note when Tascam, DAT, and hard disc recordings start and end, speed and direction changes, information on acoustic detections, and any information obtained from the flying bridge (especially the location of the animals, sighting numbers, and species IDs). A coded summary of sounds detected should be entered as a "comment" at five-minute intervals. Basically, you want to enter in all info into Whaltrak. The "whaltrak example" at the end of this manual shows a series of comments made during acoustic detections.

We will want to clearly note any "first" beamform angles for a new acoustic detection, and plot bearing angles as we approach. If the animals are detected by the visual observers, we will enter in the sighting information and note explicitly if the vocalizations we are obtaining are the same as the animals detected by the visual team. If the animals are not detected by the observers, then we will explicitly state that they are *not* our animals, and then we will want to plot beamform angles as we pass the group. When the group gets to 90˚ (passing the beam), we will want to note this time and the distance at which the animals passed the ship. This will be the closest distance, and it is important in order to determine if it was within the visual observers' effort range. Once we are able to tell the location of a group, we will want to make a red dot (by right-clicking the mouse button on the location) on the port/starboard locations. Make a note in whaltrak that the red dots are the possible locations for that group.

The whaltrak file is automatically written to C:/Whaltrak. At the end of the day the closing acoustician should copy this file to C:/Whaltrak/new and a floppy disc (labeled "Whaltrak files"); a hard copy is printed for editing. The edited version of the file is saved to C:/Whaltrak/edited and the "edited Whaltrak files" floppy disc; the hard copies of the raw data are kept in a black binder.

Greenbooks

The greenbook labeled ‘towed array’ is used to make note of acoustic detections, visual sightings, recordings, changes made to the system, etc. General comments go on the right hand page, for example, you will want to make basic notes of first detection of vocalizations, sighting information, when non-sighted groups pass the beam, and bird flocks here. Most of this information is important for the acoustician on effort to refer back to, since they cannot refer to the information stored in Whaltrak. Notes regarding Tascam recordings as well as sightings go on the left hand page for quick reference. This information is put in a specific format so it can be referenced real quick and easy.

The best way to get an idea on what/where to write notes in the greenbook is to look at the example in the back of this manual, or to take a peek at the greenbooks themselves.

There is also a green book labeled ‘Sonobuoys”. Whenever a sonobuoy is deployed, the date, time, sonobuoy channel, and sonobuoy depth are recorded in a table at the beginning of the book. Additional notes will be recorded on a separate page of the book for each sonobuoy (see equipment section on “sonobuoys”).

Sighted vs. Non-Sighted Dolphin Schools

Dolphin schools detected by the visual team ("sighted" dolphin schools) are given sighting numbers by the visual observation team. The observers "chase" the school in closing mode to determine the species identification and group size. We will occasionally hear whistles from groups of dolphins that are not seen by the visual team; for lack of a better term, we call them "non-sighted" dolphin schools. These schools are approached in "passing mode". We give these schools their own "non-sighting numbers", designated by the letters "NS" and numbered sequentially (ex, NS5 for the fifth non-sighted school).

Regardless of the type of sighting, we begin recording and beamforming once we have vocalizations. If the visual team has a sighting, we check the observers' bearing/distance against ours to see if we are detecting the same animals. If these are the same animals, we note this explicitly and continue to beamform to make sure we are hearing that particular group (in case we come upon another group during the chase). We are particularly interested in when we *first* detected the group, so we will want to note our first angle and distance.

The observers will often inform us of dolphin schools that we have not yet detected. If we do not hear any vocalizations that we can attribute to that sighting, we will want to explicitly state that there were no vocals with that group. If, as we approach a group, we begin to hear vocals from that group, we will want an update on their location so that we can determine the acoustic detection distance of that school.

If the animals are not detected by the visual observers, we continue to beamform on them, noting when they pass the beam. Once a dolphin school passes the beam without being sighted by the visual team, we can then assign it a "non-sighting number". We will want to note the first angle we detected from this group, along with the time of that detection. When the group passes the beam, we will want to note the time and the distance from the ship as they pass the beam. We can make red dots (using the right mouse button on Whaltrak) to note the possible positions (right/left side) of the dolphin school. Whenever you make a "red dot" on the screen, put in a comment (immediately) explicitly stating what the first and second red dots represent. It is not clear from the data files, so this must be stated directly. Now, measure the distance from the ship location at the point of the first detection (first angle) and the position of the group at the beam to determine the distance of the group when first detected (you may want to use a ruler). When we can no longer detect the animals, we will then want to determine the detection distance, which is the greatest distance at which we heard the school. This is often the first distance, however it may also be the last distance.

Sperm Whales

For sperm whales, the most important thing is to keep it to yourself! We are double-blind with regards to sperm whales, and it is very important that we do not inform anyone (outside of the cruise leader) about the presence of sperm whale vocalizations until they have passed abeam. When sperm whale clicks are first noted, begin recording on the Tascam, and continue recording until the group has either completely passed abeam (if we do not choose to turn on it), or until the array must be pulled in for special Sperm Whale Estimations (90 minute counts). Page the off duty acoustician to the acoustics room and have them convey the information to the cruise leader (unless you are able to talk to the cruise leader yourself). If you cannot find the cruise leader by the time the group passes the beam, and you are able to determine that they are within 3 or 4 miles, then call the flying bridge and inform them of the detection (make sure that there are no additional animals ahead of the beam!). Once we go on sperm whale ops, we are at the mercy of the flying bridge: if they want/need us, we monitor, if not, we pull that bad boy in. If the array can stay out, continue recording until we are completely finished with the group and are no longer hearing clicks.

Sperm Whales

If you hear a sperm whale before the observer team finds them, it is VERY important that you do not let them know you are hearing them. Once you have consistently beamformed on them PAST 90º (and all are past 90), then inform the flying bridge, and they will go from there. It is ok to tell the cruise leader as soon as you hear the whales, as long as you can do so without the observers knowing.

1. Start TASCAM recording
2. Note start record TASCAM in Whaltrak
3. Continually Beamform in Ishmael as time and clicks allow
4. Find the cruise leader (quietly) if you can
5. Locate sperm whales
6. Notes in Log/Whaltrak:
   - *First angle, time*
   - *Compare what you have with what rainbow click has*
   - *When clicks start/stop*
   - *Sighting information*
   - *Updates on positions from observers*
   - *Notes on changes in behavior from observers*
   - *Particularly good sounds*
7. Once all vocals are consistently past 90, then the flying bridge can be informed.
8. Continue to record until animals are no longer audible

Baleen Whales

↓

We first must work with the observers and chief scientist to determine if biopsies, etc, will be attempted with this sighting. Ideally, we would like to toss a sonobuoy early in the sighting, assuming we will not move too fast. Otherwise we can toss a buoy at the end of a sighting, as we are done with and leaving the sightings. Alternatively, if we are unable to deploy a sonobuoy, then we can try to record any vocalizations on the array

↓

Sonobuoy

1. Prep sonobuoy, pick channel
2. Set up receivers to specific channel, set DAT to record
3. Toss Buoy
4. Note in Whaltrak the time/channel information for the sonobuoy
5. Updates in Whaltrak/Log
   Right-click for a red dot at sonobuoy location
   Ship's course (magnetic)
   Where are the animals in relation to the buoy?
   How is the reception on the two channels?
   Note any particularly good signals or behaviors
6. Continue recording until reception on buoys drops beyond audible range

Towed Array

also use this alternative for unid whales

1. Begin recording on TASCAM
2. Note start recording in Whaltrak
3. Notes in Log/Whaltrak:
   Updates on positions from observers
   Notes on changes in behavior from observers
   Particularly good sounds
4. Stop recording when out of range, signals have stopped, or after one hour

Dolphin Whistles

1. Start TASCAM recording
2. Date/Time tag for CH 8
3. Note start rec on Whaltrak
4. Beamform in Ishmael
5. Notes in Log/Whaltrak:
    - *Five-minute updates*
    - *First angle of detection (and distance?)*
    - *Sighting information from observers*
    - *Time/Distance at beam (if not sighted)*
    - *Updates on positions from observers*
    - *Notes on changes in behavior from observers*
    - *Particularly good sounds*
    - *Time last heard (and distance?)*
6. IF GOOD VOCALS, SINGLE SPECIES:
    - *HD RECORDINGS*
7. Record on TASCAM until whistles stop
8. Note end recording times in Whaltrak

Remember to continue your 5 minute updates during the sighting/recording period!

Spreadsheets

There are two data spreadsheets that should be completed every few days, as time permits. Please double check your entries for errors and ask questions if any should arise. There will be shortcuts on the extra laptop computer to enter into these spreadsheets: they are titled SPLASHrecord.xls and SPLASHsightings.xls. It will be the responsibility of the acoustics assistant to make sure that these worksheets are completed by the end of the leg (including the last day!). It is advised that they are worked on daily, as information may be missing and you may have to rely on people's memory of the sighting!

The SPLASHrecord excel spreadsheet contains entries of all recordings made during the cruise. There are currently three worksheets within this workbook. There is a worksheet for DAT (sonobuoy) recordings, TASCAM recordings, and Hard Disk recordings. Every few days the information regarding recent recordings should be entered. Use decimal minutes for all Lat/Long entries (obtain from wincruz or whaltrak files), and if the end time for a recording was not noted, then this can be determined using simple math. When the recording information is entered into the spreadsheet, it should also be checked against the logbook, with missing information written into the logbook. When changes are made, a backup file should be saved on the Acoustic Recording floppy disk.

The SPLASHsightings excel spreadsheet contains basic information regarding the acoustic and visual sightings, with a separate worksheet for each. For visual sightings, data should be entered based on information from the visual observer sighting forms (not from our notes in the logbook, often things change!). All sightings should be included, whether or not there were any acoustic detections. The worksheet for non-sighted (acoustics-only) detections should be completed based on information from the Whaltrak file and the green logbook. If the information cannot be easily obtained (for example, the point of initial acoustical detection), then this should be left blank. When changes are made, a backup file should be saved on the Acoustics Sightings floppy disk.

Writing HD recordings to CD

As needed, the hard disk recordings will be backed up to CD and the external hard drive. If hard disk space becomes limited, it may be necessary to delete recordings from the hard disk. In this case it will be necessary to check the CD backups to ensure that the recordings transferred without error.

To check the recordings, open SpectraPlus (double-click on the shortcut on the desktop). If the hard disk recordings were made using Ishmael, then they will be saved as WAV files. Simply select File, then Open, then choose the appropriate signal. Check that the file works, note this in the record excel spreadsheet, and close.

If the hard disk recordings were made using the Record program, they will be saved as 16-bit binary files, and they will need to be imported. Select File, then click on Import. Select the file from the E: drive. In the window, you need to choose "Binary 16-bit". In the "Data Scaling Options", for "Define Actual Data Values", you need to choose "data value of **4096** equals **0.625** volts". (This has to do with translating from 12-bit to 16-bit; it is hardwired into the computer and will not need to be changed). For the sampling rate, you will need to check the HD recording (this will usually be either 100000 or 150000).