SONOBUOYS

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SWFSC

Introduction to Our Friend, the Sonobuoy

Sonobuoys are disposable hydrophone units surplused by the Navy, and we manage to scrounge up a few to be used in certain situations. The beneficial aspect of the sonobuoys is that since they 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.

Using sonobuoys is simple enough, although there are a lot of little things that can make life easier for the person deploying the buoy and the person analyzing the data. Below is a simple outline of what to do, then I follow with a more thorough explanation, and finally a troubleshooting guide.

SONOBUOY DEPLOYMENT

the short version

1. **To Buoy or not to Buoy?** Is it a priority species (good)? Are there multiple species of baleen whales in the area (bad)? Are the animals traveling fast (bad)? Will there be a biopsy (good)? Is there sufficient time for recording (good)?
2. **Check receiver/recorder connections:** Are all the connections in place? Start the computer spectrogram program. Are the receivers on and tuned to the correct channels? Is the recording set to 'on' in ISHMAEL.
3. **Prep Sonobuoy Notes**: Enter in the sighting and sonobuoy information.
4. **Buoy Deployment**: Recheck the channel and depth on the buoy, ask permission to toss the buoy, and throw that bad boy over. Wait to see if the float pops up. Ask the bridge/flying bridge to use hand-held radios and to minimize communication.
5. **Check Buoy**:
    a. Check the receiver: are you getting reception?
    b. Check the recording: does it look good? Are you getting both channels?
    c. Listen to the recording: do you hear ship noise? Do you hear the DIFAR?
    d. Check the spectrogram: do you see ship noise? Do you see the DIFAR?

    At this point, double-check that you are actually recording, and that the "pause" is not on!

6. **Monitor and Notes**:
    a. Change spectrogram to monitor for vocalizations
    b. Enter in all initial information (in notes)
    c. Enter all possible updates on sonobuoy/whale location (in notes)
    d. Enter in Lat/Long/Local Time updates as often as possible
7. **Death of a Sonobuoy**
    a. Is the reception on the ICOM receivers dropping below 2 bars?
    b. Is radio communication interfering with reception?
    c. Can you hear static rather than ship noise?
    d. Is there too much static on the spectrogram to see vocalizations?

    IF SO, THEN YOUR BUOY IS DYING!!!!

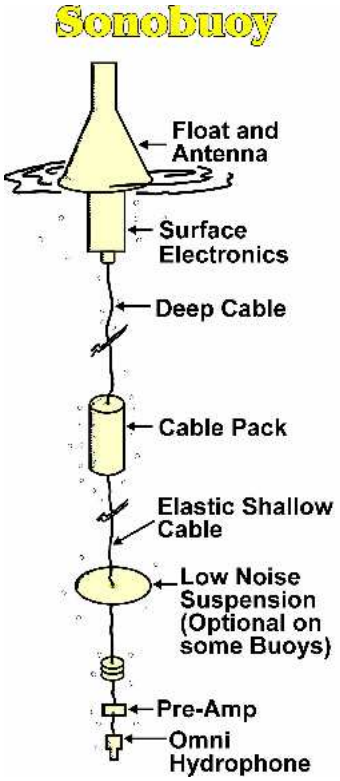
⇒ IF YOU NEED MORE TIME: ask to return to the buoy, stay approx 1nmi away from the buoy for good reception and low ship noise

⇒ IF IT IS NOT WORTH IT: then keep recording for the helluvit, and but go and enjoy the day

Anatomy of a Sonobuoy

The sonobuoy itself consists of a metal housing, often within a plastic case. Within this housing is a battery, the hydrophone, a float, and an antenna (and some cables). When the buoy is deployed, these separate out and look like the picture (below). The hydrophone hears (duh), sends the info up the wires, and the antenna sends out the information on radio frequency. We then receive this information on the ships antenna on the same radio frequency.

There are several types of sonobuoys, but they all have the same basic parts. There are "low" frequency sonobuoys and "high" frequency sonobuoys. The low frequency sonobuoys are Types 53 and 77. They have a frequency response from less than 10 Hz (low!) to 2,500 Hz (mid-range). These are ONLY to be used on baleen whales (dolphin vocalizations are too high). Both the 53 and 77 are "DIFAR" buoys, and they have locating abilities. Within these DIFAR buoys there is a magnetic compass, and information regarding the direction of the various sounds is relayed up the wires and also sent out on the radio frequency. This "DIFAR" signal is the annoying 7.5 kHz and 15 kHz tonal sound. These buoys are especially important if we need to tell the direction of a vocalizing whale, for example, if we need to positively match a biopsied whale to a vocalization to understand the gender of the vocalizing whale. The Type 57 sonobuoys are "high" frequency buoys, with a frequency response from less than 10 Hz to about 20 kHz. These are not DIFAR buoys, so they do not have the direction capabilities, however they do have a good low frequency response, so they are good for baleen whales. These are the only buoys you would use on dolphin schools.



Sonobuoy Type

53: Low Frequency DIFAR
Baleen Whales

77: Low Frequency DIFAR
. . . with vertical array
Baleen Whales

57: High Frequency
Baleen Whales
Dolphins

Radio Operation

You should monitor the sonobuoy transmissions with both ICOM radios. If you have only one sonobuoy out at a time, dial its frequency into both radios. The sonobuoy frequencies have been programmed into the radios' memory; you need to be in memory mode (**Fr/M** switch), then the channel will change when you rotate the big knob. The **Mode** should be set to Wide FM (**WFM**). You can try the Automatic Frequency Control **AFC** to fine-tune onto the carrier frequency. Try the **PRE** amp if you have a weak signal; you probably will not need the **ATT**enuator. Don't worry about any of the **SCAN** functions. The strength of the carrier frequency is displayed with a dashed bar that appears beneath the frequency display; this indicates when the sonobuoy transmission is being received (but does not indicate whether the hydrophone itself is functioning).

You should communicate to the flying bridge and the bridge command when you are recording and ask them to minimize radio transmissions (VHF transmissions interfere with the reception of sonobuoy signals) and ask the bridge command to temporarily switch to hand-held radios.

ISHMAEL Recordings

The sonobouy computer will be setup with ISHMAEL, which will be used as a hard disk recorder for the sonobuoys. Before your first buoy, setup ISHMAEL with default sonobuoy recording configurations. When you toss a buoy, start ISHMAEL, run the selected configuration, and play/record. One will be your configuration to CHECK the sonobuoys, to see if they are functioning. This will look at the full bandwidth, both channels (call it BuoyCHECK.ipf). The second one will be the configuration you will use to monitor/record from the sonobuoys, and it will be called BuoyRECORD.ipf. Below are suggested configurations to start with. Change them as appropriate for you.

Initial Setup (full bandwidth view to CHECK buoys):
Open ISHMAEL
File → Sound Card → Select sound card, sampling rate (48kHz), and channels (2)
View→ Freq Range → time scaling 0.5 sec/cm and frequency range 0 – 24000 Hz
Compute → Spec Parameters → 1024 samples
View → All Channels
View → Colors → Rainbow
Record → Record Sound → Recording → Record only when you click the Record button
Record → Record Sound → File Names → (choose folder on c: drive)
Record → Record Sound → File Names → Set File Names
Use this template: HICEAS2010-%y%M%D-%H%m%s.wav
And set GMT to + 0 (keep as GMT for this survey)
File → Save Settings As → **BuoyCHECK.ipf**

Recording Setup (monitor lower frequencies to RECORD buoys):
Open ISHMAEL
File→ Sound Card → Select sound card, sampling rate (48kHz), and channels (2)
View→ Freq Range → time scaling 0.5 sec/cm and frequency range 0 – 1000 Hz
Compute → Spec Parameters → 4096 samples
View → All Channels (or 1 channel, depending on if channels are the same buoy!)
View → Colors → Rainbow
Record → Record Sound → Recording → Record only when you click the Record button
Record → Record Sound → File Names → (choose folder on c: drive)
Record → Record Sound → File Names → Set File Names
Use this template: HICEAS2010-%y%M%D-%H%m%s.wav
And set GMT to + 0 (keep as GMT for this survey)
File → Save Settings As → **BuoyRECORD.ipf**

Sonobuoy Preparation

You will want to make sure that the sonobuoys are prepped and ready to go before you need them. To make life a little easier, put a tape label on them with the sonobuoy type, frequency and depth. This label can then be transferred to the sonobuoy notes to make sure we get that info in correctly (I have tossed buoys and forgotten what frequency they were at, that sucks). You will want 2-3 sonobuoys prepped at any given time.

When you prep the buoy, you want to take it out of the plastic case and cut off any excess garbage. First you will take off the tabs on the lid, then the lid. Take out the buoy and cut off the "L-shaped" plastic doo-hickey and the parachute. To increase the likelihood of the buoys working well, we need to take off the plastic cap on top. Usually you will need to pry off a flat bar (using a screwdriver) and then break off a plastic bar (good luck). Once that cap is removed, take off any accessory plastic to save a few more fishies, but be careful to not cut the antennae float.

We now need to set the hydrophone for the proper transmitting frequency. 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 (within two hundred miles) of any country. Also, each ship has a range of frequencies that are optimal for their antenna system. We would therefore receive signals from these channels over a greater distance. 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 (ask your Electronics Tech what the ideal frequency is). 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. For your prepped sonobuoys, choose different frequencies over the optimal frequency range. For example, if the optimal frequency for your ship is Channel 56, you will want to prep buoys at Ch 54, 56, 58.

After you choose a frequency, set it on the sonobuoy using the digital panel. 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 the surface waters. If it is a deep diving animal, you may want to set it deeper. However, if the sea state is poor, then noise from breaking waves could interfere with our recordings, so to minimize this noise you might want to set it at a deeper depth, farther from the wave action. Initially set them to the shallow setting, and then you can opt to change them later. After the buoy is prepped, label the information on the tape and put it on the lid.

In addition to sonobuoy preparation, we will want our computer/recording equipment to be prepared as well. There are so many things to do during the first few minutes of the sonobuoy deployment that it is best to have everything ready to go. Things to have always ready:

- Is the date/time on the computer correct?
- Is ISHMAEL setup and ready to go?
- Are the wires hooked up properly?

WHEN to use a sonobuoy

It is difficult to choose when to toss a sonobuoy, there are conflicting factors involved. You will need to think about the priority of this species, the presence of other species of baleen whales, the time available for operations, the number of sonobuoys you have, and how far into the cruise you are.

For whales, we want to deploy sonobuoys on priority species sightings slow-traveling animals that will be approached for biopsy operations. If the animal is traveling too quickly, both the animal and the ship will leave the area of the sonobuoy rather quickly, and the buoy will be wasted. The only fast-traveling whales we want to deploy sonobuoys on are blue whales (highest of priority). If there are multiple species of baleen whales, then we cannot be sure which species was producing the calls.

For schools of dolphins or blackfish, we will only want to deploy sonobuoys if the school is confirmed to be a single species school. The highest priority is for killer whales.

After you decide "if" you will toss a buoy, then you need to decide when to toss the buoy. If you toss a buoy at the beginning of the "chase", you will have a longer time to record, but there is a good chance that the whale will move away from the sonobuoy and that ship noise will interfere with recordings. However, if you wait too long, you may miss your chance entirely, or you may only have a very brief time to make any recordings at all. With the exception of fast-moving animals, I have generally found that it is better to deploy the buoy at the beginning of the operations. Give enough time to ensure the species identification and that there will be attempts at biopsy.

Before you head out to toss the sonobuoy, you will want to double-check the lab equipment and make sure everything is hooked up properly.

Whales:

- **BLUE WHALES!!!!**
- BRYDES WHALES
- SEI WHALES
- MINKE WHALES

Dolphins:

- KILLER WHALES

Deployment of the Sonobuoy

You will want to take a radio with you when you deploy the sonobuoy for communication. Ask the flying bridge when the best time is to throw the buoy (closest approach to the animal, if possible). You will also want to ask permission from the bridge to throw it overboard, and ask the flying bridge to mark the location in WinCruz. Watch the sonobuoy until the antennae pops up, then return to the acoustics lab. 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 buoy (and let the flying bridge and bridge know your intentions).

Good Buoy/ Bad Buoy

Maybe the most difficult part to get the swing of is determining if the buoy was good or bad. First, you want to know if the float popped up. It usually happens within 30 seconds, but sometimes this takes up to five minutes. Second, when you get in the lab, check the reception on the receivers. Are all the bars lit to show full reception? If Yes, GOOD! If no, look at troubleshooting. Third, check that you have good reception on the recording. Fourth, check the headphones. Do you hear ship noise? If it is a difar buoy, do you hear the Difar signal (high pitched tone)? If Yes, GOOD! If no, check the troubleshooting again. Finally, check the spectrogram. The first check you will do is with the "sb test" configuration. This will look at all frequencies, so that you can check for ship noise and the Difar signals. With the spectrogram in the "sb test" mode, look to see that there is a lot of low frequency noise (ship noise), and if it is a difar buoy, that you have dark lines at 7.5kHz and at 15kHz. If Yes, GOOD!! If not, then you know where to go from here…..

If your buoy is good, then you are set and you can move on to the monitoring part. If the buoy appears to be bad, then decide if you want to throw another buoy. If it is a very high priority sighting in great conditions, then toss another buoy (make sure it is a different channel!). If it is so-so conditions, you are low on buoys, or you have left the location or lost the whale, then you may want to blow this one off.

If you do decide to toss a second buoy, it should be a different channel (two channels away from the first buoy), and you will want to initially set each receiver to a different channel. Sometimes you will get the first buoy a little bit later, so you want to be ready. The receivers and DAT can handle two channels total, so you are set.

Computer Monitoring and Record Keeping

The computers can be used for visual monitoring of the vocalizations (using a real-time spectrograms, or RTS), as well as recording. Try to get the observers to enter in resightings and updates in Wincruz, if possible.

Once you have deployed a buoy, mark the location in Whaltrak, along with any relevant comments (ex, buoy number, sighting number, etc). 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 is consistently receiving. Any additional information from the observers regarding the animal's location, behavior, or other species/animals in the area is also helpful, and if there is time, it can be entered in as comments in Whaltrak. Remember that the person analyzing this data will have no idea of the situation in which the recordings were made, so any information is helpful!!

Ideally, the sonobuoys will be preset and ready to go, with a strip of labeled tape on the plastic canister. Pick the best buoy, toss it, and stick the tape on the back of the sonobuoy notesheet.

Data Logging

After you throw the sonobuoy in the water, you should monitor the sounds (visually using Ishmael and audibly using the headphones). You should completely fill out the sonobuoy data sheet.

Troubleshooting

The receivers show reception, but I can't hear the sonobuoy!

- Check the volume for the headphones, is the headphone setting correctly set?
- Check the wires from the receivers into the sound card , and from the sound card to the computer and headphones… are they setup correctly?
- Is the computer recording?
- If it is a 53 or 77 sonobuoy, can you hear the DIFAR signal (high pitched annoying tone at 7.5 kHz and 15 kHz?

Signal fades too quickly.

- Check to see that WFM mode is selected on the ICOM radio receivers.
- How far is the ship from the buoy? Ask if the ship can stay w/in 1nmi of the buoy.

No Reception on Receivers

- Did you put in the correct channel? Slowly scan all the channels and see if you get reception elsewhere.
- Did the sonobuoy pop up? Maybe it was a bad one. Give it 5-15 minutes, ask if anyone saw the float pop up.
- Do the "channels" on the ICOM receivers match the frequencies they are supposed to (check the chart)?

I sometimes hear loud interference

- Does it coincide with radio communication? If so, ask the observers and bridge to minimize radio communication, and ask the bridge to switch to handheld radios, if possible.
- Is the sonobuoy far away? As the signal gets weaker, it takes less and less to "interfere" with the signal. You may need to move closer to the buoy.

I don't have a visual display on the computer

- Is the wiring hooked up correctly, with all the connections firmly in place?
- Are both the channels of the sound card/recorder receiving good levels of input? If no, increase the recording level as necessary. If yes, then check the output to the computer (headphone jack), do you need to increase the volume?
- Check the computer settings: first look at the full spectrogram (up to 20 kHz) to see if you can see the DIFAR signals, if applicable (7.5 kHz and 15 kHz), and the roll off of the ship noise. If not, then recheck your wiring. If yes, then when you switch back to viewing for vocalizations, recheck your parameters, and maybe increase the volume.
- Give the computer a re-boot if it is acting up. Talk nicely to it.

Troubleshooting, con't

The ICOMs are set to frequencies, it won't allow me to choose by "Channel"

- Reset the FR/M switch to choose "M" for memory.

Everything was fine for a while, then the sound from the buoy turned to bad noise

- Check the ICOM receivers… are you still getting reception (>1bar)? If no, then there is a good chance your buoy died a sudden death. Still hang out for a while, they have been known to come back from the "dead".
- If you still have what appears to be "good" reception on the receivers, then reset the spectrogram to look at the full frequency range. Do you see the DIFAR signals? Do you see the roll off on the ship noise? Does it look "good" to you????

Diagrams of Wiring